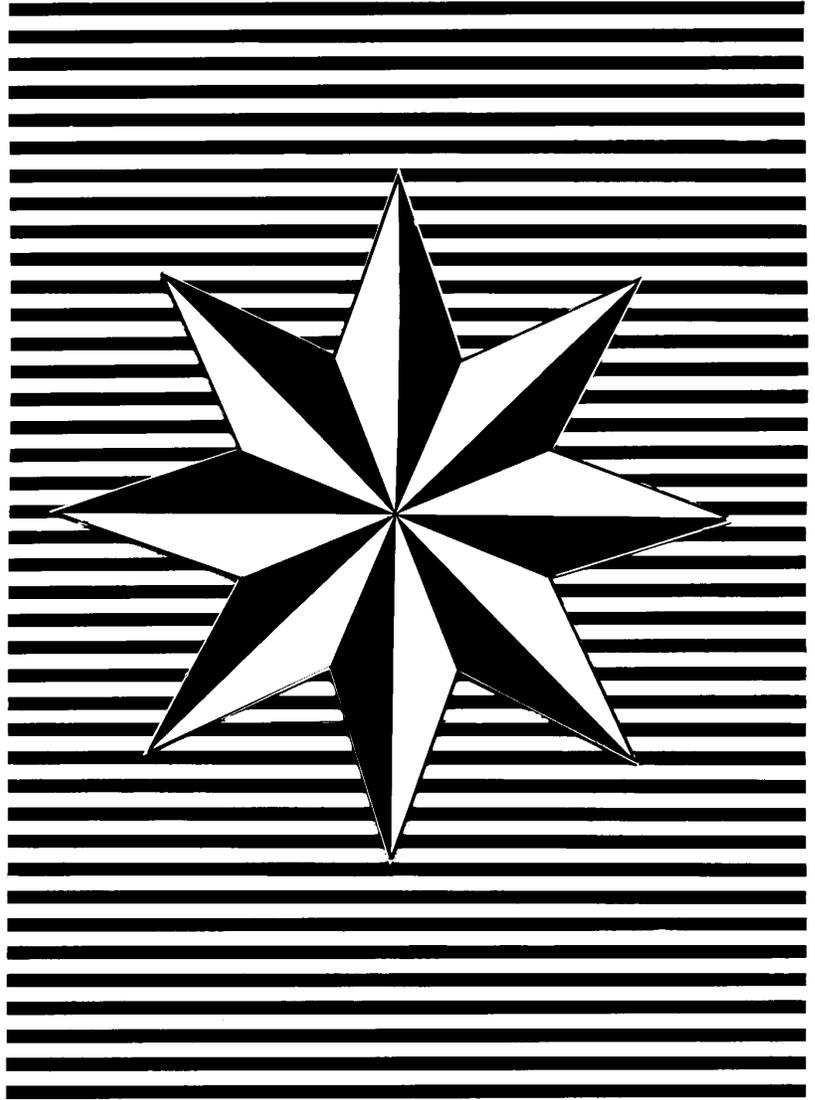


# SUMMARY OF AWARDS

FISCAL YEAR 1995



Office of Cross-Disciplinary Activities  
Directorate for Computer and Information  
Science and Engineering



NATIONAL SCIENCE FOUNDATION

# **SUMMARY OF AWARDS**

FISCAL YEAR 1995

Office of Cross-Disciplinary Activities  
Directorate for Computer and Information  
Science and Engineering

NATIONAL SCIENCE FOUNDATION  
4201 WILSON BOULEVARD  
ARLINGTON, VA 22230



# Preface

The Computer and Information Science and Engineering (CISE) Directorate, consists of the following six divisions and office: Advanced Scientific Computing (ASC) Division; Computer and Computation Research (CCR) Division; Cross-Disciplinary Activities (CDA) Office; Information, Robotics and Intelligent Systems (IRIS) Division; Microelectronic Information Processing Systems (MIPS) Division; and the Networking and Communications Research and Infrastructure (NCRI) Division.

The *Office of Cross-Disciplinary Activities (CDA)* supports the building and strengthening of infrastructure in all CISE areas through the CISE Institutional Infrastructure and the CISE Instrumentation Programs. It also administers various special projects and coordinates activities aimed at directorate- and Foundation-wide goals including increasing the participation of women, minorities, and the disabled in science and engineering, encouraging new investigators to initiate research, developing undergraduate curricula in CISE areas and encouraging the participation of undergraduates in research. The CISE Institutional Infrastructure Program had five components: Institutional Infrastructure-Research Infrastructure, Institutional Infrastructure-Large Scale, Institutional Infrastructure-Small Scale, Institutional Infrastructure-Minority Institutions, and Educational Infrastructure.

The CISE Institutional Infrastructure-Large Scale Program was discontinued in Fiscal Year 1993 and no new awards have been made. However, continuing grants in this program, whose initial awards were made prior to Fiscal Year 1993, are listed in this Summary of Awards.

The purpose of this Summary of Awards is to provide the scientific and engineering communities with a summary of those grants awarded in Fiscal Year 1995 through the Office of Cross-Disciplinary Activities (CDA). This report lists projects including continuing grants funded using Fiscal Year 1995 dollars and hence does not list multi-year standard awards made prior to Fiscal Year 1995.

Awards are grouped together by Programs for reader convenience. However, projects may bridge several programs or deal with topics not explicitly mentioned herein. Thus, these categories have been assigned administratively and for the purpose of this report only.

In this document, award identification numbers, award amounts, and award durations are identified first. Grantee institutions and award titles are enumerated after the principal investigators' name. Within each category, the awards are listed alphabetically by principal investigator.

Readers wishing further information on a particular project described in this report are advised to contact the principal investigator directly.

John C. Cherniavsky  
Head  
Office of Cross-Disciplinary Activities



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**NATIONAL SCIENCE FOUNDATION  
DIRECTORATE FOR  
COMPUTER AND INFORMATION SCIENCE  
AND ENGINEERING**

**Office of  
Cross-Disciplinary Activities**

**CDA Staff**

**FY 1995**

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**The address and telephone number for all of the above:**

**National Science Foundation  
4201 Wilson Boulevard, Room 1160  
Arlington, VA 22230  
(703) 306-1980**

## Summary—FY 1995

	Number of Projects	Value of Awards
CISE Institutional Infrastructure—Research Infrastructure	23	\$8,622,572
CISE Institutional Infrastructure—Large Scale	14	\$3,804,161
CISE Institutional Infrastructure—Small Scale	15	\$1,945,909
CISE Institutional Infrastructure-Minority Institutions	14	\$2,498,168
CISE Educational Innovation	6	\$1,464,007
Academic Research Infrastructure	15	\$9,254,063*
Combined Research-Curriculum Development	2	\$ 487,075
CISE Postdoctoral Research Associates	12	\$ 542,224
CISE Instrumentation	28	\$2,105,799
CISE Special Projects	13	\$1,212,787**
CISE Research Experience for Undergraduate-Site Grants	19	\$ 870,647

These data include the totals of the awards listed in this document including special Foundation initiatives and may not agree with official NSF budget records for CDA.

\*Funds from the Office of Science and Technology Infrastructure

\*\*Funds from Director's Opportunity Fund

# Introduction

This report provides summaries of awards made in Fiscal Year 1995 by the National Science Foundation (NSF) through the Office of Cross-Disciplinary Activities (CDA) of the Computer and Information Science and Engineering (CISE) Directorate. The programs conducted by the Office are:

## **CISE Institutional Infrastructure-Research Infrastructure**

The Research Infrastructure component of the CISE Institutional Infrastructure program integrates the prior CISE Large Scale and Small Scale components of this program. The Research Infrastructure Program provides support to aid in the establishment, enhancement, and operation of major experimental facilities planned to support research in all CISE areas. It recognizes the emergence of research groups requiring infrastructure strengthening in a variety of environments—those solely within a single academic department, those drawing from several departments in a single institution, and those which may span several different institutions.

## **CISE Institutional Infrastructure-Large Scale (discontinued in Fiscal Year 1993)**

This program has provided support to aid in the establishment, enhancement and operation of major experimental facilities supporting research activities in the areas of computer and information science, computer engineering, or computational science supported in the CISE Directorate. In general, support has been provided for equipment, maintenance, technical support staff, and other appropriate costs.

## **CISE Institutional Infrastructure-Small Scale (discontinued in Fiscal Year 1994)**

This expansion of the Institutional Infrastructure Program was established in Fiscal Year 1988 with the acceptance of proposals for five-year awards to support the establishment, enhancement and operation of experimental research facilities of a smaller scale than those encompassed by the Large-Scale Program. As in the Large-Scale program, awards are made for equipment, maintenance, technical support staff, and other appropriate costs for facilities supporting research activities in the CISE research areas.

## **CISE Institutional Infrastructure-Minority Institutions**

Both one-year planning grants and five-year continuing awards are included in the Minority Institutions program. The program includes both research and educational components and provides funds to aid in the establishment, enhancement, and operation of experimental computing facilities at predominantly minority institutions to support activities in the areas of computer and information science, computer engineering, or computational science supported in the CISE Directorate.

## **CISE Educational Infrastructure Program**

The objective of the Educational Infrastructure program is to stimulate innovative educational activities at the undergraduate level in CISE disciplines by encouraging the transfer of research results into the undergraduate curriculum.

## **Academic Research Infrastructure**

The Academic Research Infrastructure Program (ARI) is designed to improve the condition of research equipment and facilities in our Nation's academic institutions in all disciplines. This program responds to needs identified by the academic science and engineering community. Funding is provided by the Office of Science and Technology Infrastructure.

## **Combined Research-Curriculum Development (jointly with the Engineering Directorate)**

This program is managed jointly with the Directorate of Engineering. The program emphasizes the need to incorporate exciting research advances in important technology areas into the upper level undergraduate and graduate engineering curriculum. The objective of the program is to stimulate faculty researchers to place increased value on quality education and curriculum innovation in the context that education and research are of equal value and complementary parts of an integrated whole.

## **CISE Postdoctoral Research Associates**

These awards provide opportunities for recent Ph.D.'s to broaden their knowledge and experience and to prepare them for significant research careers on the frontiers of contemporary computational science and engineering, and experimental science. It is assumed that CS&E Associates will conduct their research at academic research institutions or other centers or institutions which provide access, either on site or by network, to high performance, scalable parallel computing systems and will conduct their research in academic research institutions or other institutions devoted to experimental science in one or more of the research areas supported by the CISE Directorate.

## **CISE Instrumentation**

Awards in the CISE Instrumentation program are made for the purchase of special-purpose equipment or software to be used for research programs in the areas of computer and information science, computer engineering, or computational science supported in the CISE Directorate. The instrumentation is to be used by more than one project and is not intended to provide general computing capacity.

## **CISE Special Projects**

The Office of Cross-Disciplinary Activities makes several awards in the Special Projects category and, in addition, coordinates and is responsible for funding cross-directorate projects. Projects include special activities related to women, minorities, graduate research fellows (honorable mentions) and persons with disabilities. In FY93 CISE established, as part of the NSF Graduate Research Fellowship Program, an Award for Women. Ten awards were made in FY93. Since these awards were made through the Directorate for Education and Human Resources, they are not listed in this document.

## **CISE Research Experience for Undergraduates**

Research Experience for Undergraduates (REU) provides undergraduates with hands-on training experience in active research in science and engineering. There are two categories of projects: (1) *REU Sites* and (2) *REU Supplements*. *REU Sites* are based on independent proposals to initiate and conduct undergraduate research projects for a minimum of six students. *REU Supplements* are intended to provide research experiences for one or two undergraduate students by adding support for them to existing NSF projects. *REU Supplements* are listed after the ongoing NSF grant they are supplementing.

## **Additional Information**

For additional information on any of the projects, please contact the principal investigators directly.

The Foundation provides awards for research in the sciences and engineering. The awardee is wholly responsible for the conduct of such research and preparation of the results for publication. The Foundation, therefore, does not assume responsibility for such findings or their interpretation.

In accordance with Federal statutes and regulations and NSF policies, no person on grounds of race, color, age, sex, national origin, or disability shall be excluded from participation in, denied the benefits of, or be subject to discrimination under any program or activity receiving financial assistance from the National Science Foundation.

The National Science Foundation has TDD (Telephonic Device for the Deaf) capability which enables individuals with hearing impairment to communicate with the Division of Human Resources for information relating to NSF programs, employment, or general information. This number is (703) 306-0090.

Facilitation Awards for Handicapped Scientists and Engineer (FAH) provide funding for special assistance or equipment to enable persons with disabilities (investigators and other staff, including student research assistants) to work on an NSF project. See the program announcement, or contact the program coordinator for more information at (703) 306-1697.

The Foundation welcomes proposals on behalf of all qualified scientists and engineers, and strongly encourages women, minorities, and persons with disabilities to complete fully in any of the research and research-related programs described in this document.

Catalog of Federal Domestic Assistance Number 47.070, Computer and Information Science and Engineering.



# CISE Institutional Infrastructure (Research Infrastructure)

CDA-9401021

\$254,526—12 mos

Ambler, Allen L.

University of Kansas Center for Research

## DesignLab

This award provides support for the establishment of the Design Technologies Laboratory, or DesignLab. The laboratory will stimulate experimental research in technologies fundamental to building design support tools. Many such design support technologies are inherently nonprocedural and ill-suited to von Neumann uni-processor architectures. Efficient implementation strategies demand parallel and distributed computing environments with large shared memories and/or ultra high-speed interconnections. The requested equipment includes a 16-processor SGI Challenge and a very high speed network. The research topics to be explored include intelligent information databases for multimedia and 3D drawings; computer vision, modeling and visualization; declarative design specification languages; collaborative multi-agent design; meta-languages for defining reasoning systems; implementation strategies for non-procedural design technologies; and applied design technologies.

CDA-9401124

\$348,850—12 mos

Campbell, Roy H.

University of Illinois, Urbana-Champaign

(Split funded with the Division of Computer and Computation Research \$100,000) Total award \$448,850

## Broadband Network Infrastructure and Data Storage for Research and Education

This award provides support for an experimental, high-speed network infrastructure that would interconnect parallel systems, large-capacity secondary and tertiary storage devices, and multi-media workstations capable of supporting high-quality digital audio and video. The network architecture is based on a broadband ISDN backbone of Asynchronous Transfer Mode (ATM) switches and fiber optics links. A high-bandwidth, gigabit/second HIPPI network would interconnect an Intel Paragon distributed memory parallel system and a tertiary storage system. The research spans three basic areas: system software infrastructure for managing high-speed networks, data pre-fetching and staging policies for high-latency, high-capacity secondary and tertiary

data stores, and information access and multimedia collaboration software.

CDA-9303150

\$150,000—12 mos

Cohen, Jacques

Brandeis University

## Parallel Computing and Complex Systems

This award is for the acquisition of a parallel computer and several high performance work stations to support research in the Computer Science Department of Brandeis University. The department is engaged in three major areas of research: Parallelism and Languages, Data Compression, and Artificial Intelligence. The department is part of the Brandeis Center for Complex Systems and the theme of parallelism and the study of large complex systems is common to all three groups. The research topics to be explored by the parallel programming group include the design and analysis of parallel algorithms; and the design and implementation of high level parallel languages which facilitate the rapid construction of programs that can easily be verified to be correct and which can be compiled to run efficiently on MIMD and SIMD machines. Research topics of the data compression group include adaptive vector quantization with variable size vectors, adaptive video compression, issues in coding theory that include error resilient communication, the design of high speed data compression hardware, and context prediction for lexicography. Research topics for the AI group include data extraction from existing databases and text corpora, the role of memory in storing extracted data, and the construction of integrated agents that are data driven and exhibit goal directed behavior.

CDA-9541267

\$14,781—06 mos

Davis, Larry

University of Maryland, College Park

## Systems and Software Tools for High Performance Computing

In 1994, the University of Maryland received a 3-year Research Infrastructure award to support the acquisition of a distributed memory parallel computer together with support hardware for scientific visualization and storage of large image databases. The research topics to be explored span a broad range of applied research in high performance computing in three general

categories: programming tools for HPC systems, parallel algorithms for scientific computing, and symbolic coding.

This ROA award will provide 2 months of salary support for Dr. Ruth Silverman to spend her sabbatical year at the University of Maryland. Dr. Silverman is a faculty member at the University of the District of Columbia (UDC), a Minority University. Dr. Silverman will be pursuing research in the development of efficient parallel algorithms for geometric problems.

CDA-9303433

\$400,000—12 mos

DeFanti, Thomas A.

University of Illinois, Chicago

#### **CISE Research Infrastructure**

This award is for the establishment of a laboratory for research on the design, implementation, dissemination, and use of highly interactive computing technologies for the benefit of computational, biomedical and engineering sciences. The application areas share the need for very high-speed data capture and presentation facilities, very high bandwidth communication, and very large information stores. The research topics to be explored by this laboratory include the design and implementation of virtual reality environments; the storage, retrieval, and navigation of very large information stores; the design and evaluation of user-centered domain-specific, multi-media applications; and the remote, shared access to specialized instrumentation resources. The researchers come from the Computer Science Department, the School of Art and Design, the Department of Electrical Engineering, the Department of Bioengineering, and the Laboratory for Biomedical visualization. Extensive collaborations are in place with the National Laboratories. The award provides for the acquisition of instrumentation to match this research. The laboratory will consist of the CAVE Virtual Reality Theater, a Database Computing Facility, an Interactive Multimedia laboratory, and a Networked Remote User Facility. The instrumentation provided consists of high performance visualization computers, mass storage devices, and high speed communications equipment.

CDA-9541981

\$20,000—06 mos

DeFanti, Thomas A.

University of Illinois-Chicago

#### **CISE Research Infrastructure**

In 1993 the University of Illinois at Chicago was awarded a Research Infrastructure grant to support the establishment of a laboratory for research on the design, implementation, dissemination, and use of highly interactive computing technologies for the benefit of computational, biomedical and engineering sciences. The research topics to be explored by this laboratory include the design and implementation of virtual reality environments; the storage, retrieval, and navigation of

very large information stores; the design and evaluation of user-centered domain-specific, multi-media applications; and the remote, shared access to specialized instrumentation resources. The laboratory includes the CAVE Virtual Reality Theater, a Database Computing Facility, an Interactive Multimedia laboratory, and a Networked Remote User Facility.

This REU supplement provides support for four undergraduate students to work with Dr. Thomas DeFanti on research in Virtual Reality. The students will be able to choose from projects in hardware integration and development associated with building a scalable workstation, system software architecture design, human/computer interaction and navigation, virtual environment documentation tools, and virtual environment library and emulators.

CDA-9542704

\$790,500—12 mos

DeFanti, Thomas A.

University of Illinois

#### **A National Scale Distributed Computing Environment--A National Testbed for Security Conscious Distributed Scalable Computing and Shared Visual & Virtual Environment Applications**

This award to the University of Illinois at Chicago is under the direction of Dr. Thomas DeFanti and entitled "A national Scale Distributed Computing Environment." This project is part of a multi-year ongoing effort of the Electronic Visualizations Laboratory (EVL), in partnership with the National Center for Supercomputing Applications (NCSA) and the Mathematics and Computer Science Division of Argonne National Laboratory (ANL), to develop highly leverage national collaborations using HPCC technologies, virtual reality, and scientific visualization. The goals are to encourage developments of teams, tools, hardware, system software and human interface models on an accelerated schedule to enable national-scale, multi-site collaborations to facilitate solutions to National Challenge and Grand Challenge problems. It is expected that new paradigms for networking and scalable computing interoperability and optimization will result, as well as methods for graphical user interaction. The project will also be involved with the development of the Information Wide Area Year (I-Way), an experimental high-performance network linking dozens of the country's fastest computer and advanced visualization environments. The network will be based on Asynchronous Transfer Mode (ATM) technology, an emerging standard for advanced telecommunication networks. This network will provide wide-area high-performance backbone for various experimental networking activities at Supercomputing 95. Users will be those groups submitting projects to the NII Tested and High Performance Computing Challenge events (which is part of the Supercomputing 95 Call for Participation) to develop and demonstrate large-scale simulation, interactive CAVE applications. Other users will

include those viewing live and recorded video across the network for video server demonstrations. The Advanced Research Projects Agency (ARPA) co-funded this award along with other NSF divisions.

CDA-9502979

\$665,368—12 mos

Du, David H.

University of Minnesota-Twin Cities

CISE Research Infrastructure: Application Over High-Speed network: A Pilot Project for the NII.

This award provides support to develop a prototype distributed computing, storage and scientific visualization facility for the National Information Infrastructure (NII). Key elements of the facility include a distributed parallel storage system with several physically distributed RAID systems with high speed ATM connections and a high-bandwidth disk system with direct connection to a FIBER Channel switch, a distributed computing server with clusters of high-end workstations and multiprocessors, a high resolution display unit, and a high-speed local, metropolitan, and wide area network infrastructure.

Projects include technology development in the areas of multimedia servers and database servers; network research in the areas of network design, control and performance; and research in parallel architecture and system software. Applications areas to be supported include manufacturing, healthcare, scientific computing, and scientific visualization.

CDA-9303152

\$304,001—12 mos

Ehrich, Roger W.

Virginia Polytechnic Institute & University

**Interactive Accessibility: Breaking Barriers to the Power of Computing**

This award provides infrastructure for the support of laboratories for research in interactive computing, especially as it relates to human/computer interface studies. The principal investigators are drawn from the department of Computer Science and the department of Industrial and Systems Engineering. In addition, there are substantial collaborations with the Naval Research Laboratory and the Blacksburg Electronic Village. The laboratories are a Usability Methods Research Laboratory, an Interaction Technology Laboratory, and an Information Access Laboratory. This award is being jointly funded by the Cross Disciplinary Activities(CDA) Office and the Information, Robotics, and Intelligent Systems(IRIS) Division. The Instrumentation for the laboratories is being supported by CDA while the research is being supported by IRIS. The specific research performed in the laboratories includes identifying and overcoming usability and conceptual barriers to computing, the development of evaluation methodologies for determining the effectiveness of human/computer interfaces, development of environments for perform-

ing human/computer interface experiments, the development of expert-based information systems, the development of systems for access to computers for disabled users, and development of several domain based interfaces for large data base systems.

CDA-9401156

\$548,206—12 mos

Ferrari, Domenico

University of California, Berkeley

**A Next Generation Infrastructure for Integrating Computing and Communications**

This award provides support for the development of Titan, a computing system consisting of an integrated ensemble of computing and communication elements, organized to provide the user with a number of services. These services will include multimedia capabilities in delivery vehicles; storage and communication; large computing power; large storage space; innovative parallel languages, debuggers, and libraries; and high accessibility from both mobile and fixed locations. The experimental facilities requested include workstations and servers constituting the backbone of the distributed system providing cycles to the user, ATM switches for linking workstations and servers, a video editing system, a massive storage unit, and equipment for linking the network to the currently available CM-5 parallel computer. The proposed research projects fall into three areas: network and communications; distributed supercomputer projects which are mainly concerned with providing parallel computing to every user through a combined architecture, operating systems, and programming language effort; and multimedia services which requires integrating systems support, software support, and artificial intelligence tools to create, store, play, edit, search, input, and output multimedia objects. The networking, multimedia, and computing aspects of Titan will form the infrastructure for a number of computationally intensive applications.

CDA-9501637

\$661,050—12 mos

Fujimoto, Richard

Georgia Tech Research Corporation—GIT

**CISE Research Infrastructure: Distributed Laboratories**

This award provides support for infrastructure at Georgia Institute of Technology in the form of three distributed laboratories where individuals at geographically distinct locations can interact with each other on-line using powerful, distributed computational tools, to solve shared problems. The infrastructure will include a multi-granular compute server and ATM switch, a video server with high-performance multi-media workstations, and network equipment. The research topics to be explored include interactive steering, distributed simulations, collaborative systems; large-scale community, ATM and wireless networks.

CDA-9401024  
\$309,564—12 mos  
Grosz, Barbara J.  
Harvard University

**Infrastructure for Research towards Ubiquitous Information Systems**

This award provides support for the development of a new generation computing facility to support experimental research in ubiquitous information systems. The equipment infrastructure includes Asynchronous Transfer Mode (ATM) networks, file servers capable of handling video, and graphics workstations with advanced human interface capabilities. The research topics to be explored span the development of new technologies that support rapid transmission of large amounts of data between computer systems to the development of more flexible and adaptable systems for human-computer communication.

CDA-9542908  
\$4,500—0 mos  
Grosz, Barbara J.  
Harvard University

**Infrastructure for Research towards Ubiquitous Information Systems**

This award provides support for the development of a new generation computing facility to support experimental research in ubiquitous information systems. The equipment infrastructure includes Asynchronous Transfer Mode (ATM) networks, file servers capable of handling video, and graphics workstations with advanced human interface capabilities. The research topics to be explored span the development of new technologies that support rapid transmission of large amounts of data between computer systems to the development of more flexible and adaptable systems for human-computer communication.

CDA-9502631  
\$563,000—12 mos  
Hanrahan, Patrick  
Stanford University

**CISE Research Infrastructure: High Performance Graphics and Imaging**

This award provides support for a high performance giga-flop compute server, a high performance 3D graphics server, a high performance image/video/data server, and a high bandwidth network to couple these machines together. The requested equipment will contribute to the computational infrastructure of a new computer graphics laboratory.

Many national challenges such as health care, education, manufacturing, and crisis management, require graphics and imaging technologies. The investigators will be working in the areas of graphics systems and algorithms, involving research in efficient rendering algorithms, high-performance graphics architectures, and coupling compression and graphics; in scientific visu-

alization with research in volume rendering for scientific and medical applications; in vision and graphics with research in the digitization of 3D models; and in imaging and video with a focus on the manipulation of image and video databases.

CDA-9503064  
\$347,836—06 mos  
University of New Mexico  
Hollan, James

**CISE Research Infrastructure: Effective Information Access: Computer Science Research Fundamental to Creation of a National Information Infrastructure**

This award provides support for visualization facilities, servers to support distributed simulation, and a high-speed cluster network. In addition the University of New Mexico will establish a National Information Infrastructure (NII) Experimental Laboratory in the Science and Engineering Library to serve as a shared research testbed, as well as to facilitate efforts in distributed simulation and research collaborations in Biology, with the Santa Fe Institute and the National Laboratories. The Laboratory equipment will include graphics workstations connected via a high-performance local area network to high-end symmetric multiprocessing systems, an SGI Power Onyx and Power Challenge, and to remote high-performance facilities at the Maui High Performance Computing Center's IBM SP-2, the Sandia National Laboratory's Intel Paragon, and the Los Alamos National Laboratory's CM-5.

The University will build on its existing strengths in adaptive computation, human computer interaction, information analysis, and simulation to focus on adaptive multiscale interfaces; distributed computation, communication, and security for network-based applications; data mining and filtering; and improved access to distributed simulation.

CDA-9502639  
\$395,000—12 mos  
Kurose, James F.  
University of Massachusetts, Amherst

**CISE Research Infrastructure: Infrastructure to Support Research on Networked Multimedia Information System**

This award provides support to equip a networked, experimental testbed to enable research in the development of the operating system, I/O, networking, object management, and information retrieval components of future networked multimedia information systems. The testbed will consist of two shared-memory multiprocessor facilities attached to several parallel mass storage I/O devices and a high-speed ATM network.

The research team will be developing several key hardware and software technologies needed to support future networked, multimedia information systems. Specific research areas include operating systems, I/O, networking, object management and information retrieval.

CDA-9401142  
\$298,059—12 mos  
LeBlanc, Thomas J.  
University of Rochester

**Rapid Prototyping of Parallel Robot Vision Systems Using VirtualReality and Systems Simulation**

This award provides support for the establishment of a laboratory that uses two types of simulation technologies in the design of visually controlled robotics systems. The first type of simulation technology is the simulation of sensory interaction with physical environments, popularly known as “virtual reality”. Virtual reality can replace the real world in testing and debugging a system. The second is execution-driven simulation of complex parallel algorithms at the level of individual messages and memory accesses, which can address the performance and low-level real-time problems of interacting processes. The experimental facilities requested include a Silicon Graphics Reality (SGI) Engine for scene generation in the simulated world, an upgrade of an existing SGI Challenge multiprocessor for simulation of the virtual world and control software, a computational engine for performing real-time intermediate to high-level vision, a hydraulic robot arm for real-time manipulation, a small-scale multi-processor for device control and medium-level vision, and general purpose workstations. The focus of the proposal is the development of simulations to aid in the development of real-world robotic systems. Research topics to be explored include the development of principles for constructing complex physical autonomous systems; the development of new modes of simulation for virtual reality, and simulation and implementation of robotic control algorithms.

CDA-9500991  
\$389,999—12 mos  
Myers, Eugene  
University of Arizona

**CISE Research Infrastructure: A Laboratory for Scalable Systems**

This award provides support for the research infrastructure necessary to investigate the viability of building scalable systems from commodity components. Hardware components will include workstations and ATM switches. Research topics to be conducted include the design of an operating system that scales with processor performance; and the design, implementation and experimentation of five different scalable systems: DNA Assembly Server, Scalable Storage Server, Cluster-C\* applied to remote sensing, a general computing environment based on an efficient fine-grain parallelism on multiple processors, and a parallel simulator.

CDA-9502956  
\$621,752—12 mos  
Schnabel, Robert B.  
University of Colorado, Boulder

**CISE Research Infrastructure: High Performance Infrastructure for Computational Science**

This award provides support for high-speed networking equipment, high-performance multiprocessor workstation servers, a high-speed disk array, and multimedia devices for collaboration, exposition and visualization. The University of Colorado Department of Computer Science will be addressing issues of data movement in Grand Challenge and National Information Infrastructure (NII) applications. This in conjunction with the floating point needs of Grand Challenge computations, leads to their request for high-speed computation, and communication infrastructure.

The research associated with the infrastructure falls into four inter-related projects in the area of scientific computing, distributed systems, and resource discovery. These four projects are data movement in Grand Challenge computing, global optimization algorithms for molecular configuration problems, compiler-assisted network runtime systems, and resource discovery and information sharing.

CDA-9502645  
\$130,000—12 mos  
Truszczynski, Miroslaw  
University of Kentucky Research Foundation  
(Split funded with the Office of Systemic Reform \$500,000)  
Total award \$630,000

**CISE Research Infrastructure: A Laboratory for Research in High Performance Distributed Computing**

This award provides support for the acquisition of a high-performance distributed cluster-based computing system consisting of a number of high-performance multiprocessor workstations interconnected by a high-speed LAN. These LAN-connected clusters will themselves be interconnected by a high-speed ATM backbone network. The Computer Science Department will thus build a distributed multicomputer based on a scalable, distributed shared memory paradigm which will facilitate the Department's research efforts in distributed and parallel computing, distributed multimedia, vision and scientific computation, and distributed control for manufacturing.

CDA-9401159  
\$368,852—12 mos  
Turner, Jonathan S.  
Washington University

**A Research Infrastructure for Fast Image and Visualization Distribution**

This award provides support for extending and enhancing a broadband multi-media network to support a set of closely related collaborative research activities in the area of distributed imaging and visualization. The

network will utilize Asynchronous Transfer Mode (ATM) technology for the fast distribution of high-resolution images, visualizations, studio-quality video and multi-rate data. The research topics fall into two categories: research on enabling technologies such as scalable networks, host/network interfaces supporting multimedia applications, design and analysis of large-scale multimedia information servers, protocols and operating systems, scalable parallel processing and declarative visualization. And secondly, research on the application of these technologies to real distributed imaging and visualization systems.

CDA-9303181

\$327,968—12 mos

Warren, David S.

SUNY, Stony Brook

**PROUD: Parallel Resources on User's Desks**

This is an award for equipment to investigate the development and scalability of algorithms and systems for parallel computers. The instrumentation to be acquired include a number of high performance parallel workstations, a scalable distributed memory multiprocessor, and a high speed network. The research supported by this infrastructure includes organic chemical synthesis, automated theorem proving, very high speed transaction processing, parallel prolog, 3-D graphics and volume visualization, and simulations of massively parallel computers.

CDA-9303189

\$173,674—12 mos

Wise, David S.

Indiana University, Bloomington

**An Infrastructure for Conceptualization and Visualization**

This award provides infrastructure for the support of Conceptualization and Visualization of Computation.

The equipment supported includes high performance graphical workstations, a parallel computer, and high speed networking facilities. The faculty involved in the project are drawn from the Department of Computer Science but have substantial collaborations with computational scientists and engineers at Indiana University. The research supported by this infrastructure includes automated theorem proving, circuit validation, parallel functional programming, scientific visualization, visualization of Monte Carlo methods, visualization of processor utilization on scalable architectures, visual programming, and visual performance monitoring and analysis.

CDA-9502791

\$539,586—12 mos

Zwaenepoel, Willy

William Marsh Rice University

**CISE Research Infrastructure: Multi-processor Cluster Computing (A Research Infrastructure Proposal)**

This award provides support for the acquisition of a cluster of shared-memory multiprocessor nodes interconnected by a high-speed network to support research in parallel programming systems, and algorithms and applications from a wide variety of disciplines. The infrastructure will be used as a research vehicle for computer systems designers as well as computational scientists.

Research projects to be supported include work on compiler and runtimes for multiprocessor clusters, high-performance I/O, and performance visualization; and algorithms and applications in mixed integer programming, molecular dynamics, reservoir simulation, genetic linkage analysis, and seismic modeling. The infrastructure will also be used in new graduate and undergraduate courses in multidisciplinary design optimization, and parallel computing.

# CISE Institutional Infrastructure (Large Scale)

CDA-9024735

\$273,744—12 mos

Galil, Zvi

Columbia University

## Infrastructure for Computer Science

This is an infrastructure award to support the acquisition of a high speed network of data servers, computation servers, parallel processors, and workstations for the support of research in software, artificial intelligence, and parallel algorithms. The software research is in operating systems, wireless distributed systems, parallel processing, and software engineering. The artificial intelligence research is in intelligent multimedia interfaces and vision and robotics. The parallel algorithms research is in parallel string matching with applications to genome matching. New networking technologies make it possible to support computation intensive activities distributed across networks. This support requires new software tools that will support distributed and parallel computing. This award is for the infrastructure necessary to test this new software and also for the infrastructure necessary for research in robotics and parallel algorithms for large information system searches. The operating system research concentrates on a high performance operating system for distributed and parallel computers. The distributed systems research is for research in wireless distributed computing in which the transmission medium consists of radio waves. This research promises the true portable workstation in which no wires whatsoever are needed in order to access the network. Both the parallel processing and the software engineering research involve rule based systems. The parallel processing research uses rule based systems to distribute computational tasks while the software engineering research uses rule based systems to coordinate cooperative work amongst multiple software developers. The multimedia research involves the construction of virtual realities for the manipulation of multi-dimensional data. The example application area is financial data. The vision and robotics research is aimed at processing multiple sources of spatial data in order to navigate a robot in a natural environment and to control robot manipulators. Finally, the parallel algorithms research is concentrated on string matching algorithms applicable to data arising from genome databases. This research is important for actually using large databases that will arise from the human genome project.

CDA-9024600

\$328,100—12 mos

Hopcroft, John E.

Cornell University

## A Distributed Computing Facility

This infrastructure award is for the construction of a distributed computing facility. The network consists of desktop workstations connected over a medium speed network to back-end computation and data-storage servers on a high-speed network. The back-end resources consist of mid-speed compute servers, shared memory parallel multiprocessors, and massively parallel machines. The research supported by this infrastructure includes work in applied logic using the constructive type theory supported by Nuprl; in scientific computing in developing algorithms that effectively utilize distributed and massively parallel computing resources; in modeling and simulation for robotics applications; and in software for distributed computing. Many problems in experimental computer science require peak resources not available on a single workstation. These resources could be computation cycles or memory. An emerging solution to this problem is to utilize idle processors in a network of workstations and compute servers. The realization of this solution still requires much research into mechanisms for breaking problem into pieces so as to minimize communication overhead while distributing the computation to make best use of the available processors. The distributed computing researchers at Cornell University will use their distributed computing facility as a testbed for distributed algorithms. Three active areas of research at Cornell will especially benefit from this facility. The applied logic group uses a system called Nuprl developed at Cornell to support constructive reasoning. With the use of this tool, open questions in combinatorics and programming language have already been answered. The scientific computing group is already involved in the construction of a software package called LAPACK for linear algebra routines that involves constructing new algorithms for parallel and distributed machine architectures. Finally the modeling and simulation group requires substantial computational resources to enable them to use the computing resources as an experimental testbed allowing designs to be tested without the expense of constructing a robot.

CDA-9024721  
\$171,513—12 mos  
Henderson, Thomas C.  
University of Utah

### **Computer Aided Prototyping**

This Institutional Infrastructure award is to support research in the general area of Computer Aided Manufacturing Engineering. The approach taken by the Utah group is computer aided prototyping of objects to be manufactured. The process is broken down into three separate areas of research: design, prototyping, and validation. The design aspect of the research involves enhancing the Alpha 1 computer aided geometric design system. This system is able to mathematically describe objects to be manufactured. It is enhanced by incorporating some commonly occurring manufacturing steps into the model as special elements (e.g., this hole is to be counterbored). The proto-typing aspect is to take the mathematical description of the object (say a gear) and generate the NC codes and the tooling sequences necessary to actually produce the item on a machine center. The University of Utah already possesses a five axis machine center, a CNC turning center, 3-D polymer equipment, and robotics equipment and so can experimentally validate their research. A long term goal is to optimize the tooling sequences and other necessary manufacturing activities in order to have the factory operate without human supervision. This prototyping facility would also be used in collaborative work with Dr. Jacobsen's Center for Engineering Design. This center designs and manufactures many prototype items. The use of computers to aid and guide manufacturing is more common in Japan and the European countries than in the United States. This Institutional Infrastructure award is for the support of an automated manufacturing laboratory that will allow the quick design and prototyping of manufactured items. Once the prototype is deemed acceptable, methods of improving the manufacturing of the item, particularly in small batch numbers, can be explored. The University of Utah has a long history of successful industrial collaborations and it is expected that the results of this research will be widely disseminated to the United States manufacturing industry.

CDA-9541030  
\$49,955—12 mos  
Henderson, Thomas C.  
University of Utah

### **Computer Aided Prototyping**

This supplement is for the development of a test set of physical objects defined by computer aided prototyping. This test set will be initially used as a benchmark suite for image understanding of man-made objects in order to compare and calibrate for image understanding systems used in conjunction with automated manufacturing.

CDA-9542621  
\$5,000—06 mos  
Henderson, Thomas C.  
University of Utah

### **Computer-Aided Prototyping**

In Fiscal Year 1990 the University of Utah received a 5-year award from the Institutional Infrastructure Program/Large Scale program, to support an automated manufacturing laboratory that would allow the quick design and prototyping of manufactured items.

This REU supplement requests support for one student, Shiryl White, a Mechanical Engineering student from North Carolina A&T University. Ms. White will be working on an identification and tracking system utilizing a state-of-the-art binocular robot head.

CDA-9123308  
\$204,485—12 mos  
Levy, Henry  
University of Washington

### **High Performance Parallel/Distributed Computing**

This award supports infrastructure for research in high performance parallel/distributed computing. The award supports the purchase of a high performance distributed memory computer. The award also supports a programmer to develop, maintain, and distribute software developed on this computer. The research supported by this infrastructure is of two forms: compute intensive research and systems applications research. The computer intensive research includes computer vision, computer graphics, simulations, 3-D animation, and computational chemistry. The systems applications research includes developing fast operating system kernel service routines, programming models of parallel computation activities, software engineering environments, and fundamental research on parallel algorithms for distributed memory computers.

CDA-9318145  
\$200,000—12 mos  
Messina, Paul  
California Institute of Technology  
(Split funded with Division of Advanced Scientific Computing \$133,000, Division of Networking and Communications Research and Infrastructure \$100,000, Division of Computer and Computation Research \$100,000 and Division of Electrical and Communications Systems \$75,000) Total award \$608,000  
**Parallel I/O Methodologies for I/O Intensive for Challenge Applications**

The Grand Challenge Application Groups competition provides one mechanism for the support of multidisciplinary teams of scientists and engineers to meet the goals of the High Performance Computing and Communications (HPCC) Initiative in Fiscal Year 1993. The ideal proposal provided not only the opportunity to achieve significant progress on (1) a fundamental problem in science or engineering whose solution could be advanced by applying high performance computing

techniques and resources, (2) enabling technologies which facilitate those advances, but also significant interactions between scientific and computational activities, usually involving mathematical, computer or computational scientist, that would have impact in high performance computational activities beyond the specific scientific or engineering problem areas(s) or discipline being studied. This multi-disciplinary project will investigate and develop strategies for efficient implementation of I/O intensive applications in computational science and engineering. Scalable parallel I/O approaches will be pursued by a team of computer scientist and applications scientists who will work together to:

- Characterize the I/O behavior of specific application programs running on large massively parallel computers
- Abstract and define I/O models (templates)
- Implement and test application-level I/O tools on large-scale computations

The Pablo performance analysis environment will provide the foundation for the performance instrumentation and analysis. The application programs are already fully operational on advanced architecture systems and their authors are all co-investigators in this project. The principal computers used will be the Intel Touchstone Delta and Paragon systems at Caltech, each with over 500 computational nodes. Five application areas will be included: fluid dynamics, chemistry, astronomy, neuroscience, and modelling of materials-processing plasmas. The parallel programs for these applications cover a range of I/O patterns and volume, and the techniques that will be developed in this project will be of relevance to a broad spectrum of engineering and science applications. In addition, by overcoming their current I/O limitations, the specific applications targeted in this award will achieve significant new science and engineering results. By the end of the project, sustained teraFlops computers will become available. The project will devise and implement general methods for scalable I/O using today's advanced computers, immediately apply those methods to carry out unprecedented applications in several fields, and use the methods and experience gained in the first half of the project to tackle the I/O issues in future sustained teraFlops computers. This project will be carried out by a team of researchers who have many years of experience in using parallel computers for large-scale applications, in measuring and characterizing the behavior of applications on such computers, and in creating methods and tools that facilitate the use of such systems. Building on this considerable experience, the project will concentrate initially on exploring the I/O behavior of existing applications and on devising ways to get adequate and scalable I/O performance. The five application areas included in this award cover a wide range of I/O needs and behavior, including the use of out-of-core methods, reading data from

high-speed instruments, interactive and irregular data flows in modelling, and pipelining of data from distributed computing resources on high-speed networks. A key part of the approach is an integration effort that will concentrate on ensuring close communication and synergy among the components of the project and on integrating the results. The primary objective of the project is to develop methods and insights that are as generally applicable as possible. This award is being supported by the Advanced Projects Research Agency as well as NSF programs in engineering and computer science.

CDA-9415797

\$1,300,000—12 mos

Messina, Paul

California Institute of Technology

#### **Scalable I/O Initiative**

This award supports the infrastructure for the Scalable I/O national project. This national project will investigate many of the issues surrounding the scalability of Massively Parallel Processing (MPP) System input and output systems. The national project consists of 18 application groups involving more than 30 researchers. The equipment provided by this award consists of I/O nodes for an MPP and a small MPP for crashable experimentation. The infrastructure will be available to all of the application groups for their experimental research needs.

CDA-9540767

\$10,000—12 mos

O'Donnell, Michael

University of Chicago

#### **The University of Chicago Computer Science Laboratory**

In Fiscal Year 1989, the University of Chicago received a 5-year award from the Institutional Infrastructure-Large Scale program, to support the development of computing infrastructure for a wide variety of research projects. The primary research areas under investigation are equational logic, case-based reasoning, computer vision and graphics, numerical solution of partial differential equations, and computer science theory. This REU supplement provides support for two students to work on research projects concerning interface design and visual aspects of multimedia systems, and information retrieval and user interface.

CDA-9123502

\$330,000—12 mos

Rice, John R.

Purdue University Research Foundation

#### **Softlab—A Laboratory for Computational Science**

This award is to support the building of Softlab, a laboratory that supports research in computational science and engineering. The facilities provided include:

1. High performance graphics processors for scientific visualization, geometric modeling, and multime-

dia and graphical user interfaces for parallel programming in the large.

2. High-performance computing power, upgrading Purdue's parallel

3. Software and development support staff assisting application researchers in making full use of this facility comprising a rich spectrum of high-performance workstations, powerful parallel machines, and dedicated graphics processors.

4. A teaching laboratory providing exploratory course that migrate cutting-edge research into the curriculum with access to state-of-the-state facilities. This laboratory will be the principal facility of a proposed new interdisciplinary graduate degree program in Computational Engineering and Science.

CDA-9542351

\$20,000—6 mos

Schnabel, Robert B.

University of Colorado

#### **Effective Use of Parallel and Distributed Computing**

This REU Supplement requests support for four students, one to work on tuning a database consolidation program and measuring its suitability as a search filter, and the other three to work on projects chosen from building experimental networks and conducting performance measurements, and operating systems.

CDA-9024618

\$136,467—12 mos

Vernon, Mary K.

University of Wisconsin-Madison

#### **PRISM: A Laboratory for Research in Future High-Performance Parallel Computing**

This infrastructure award is for the acquisition of a SIMD and a MIMD parallel computer for the support of research in the areas of parallel programming tools, programming languages, databases, parallel optimization algorithms, scientific computing, computer architecture, artificial intelligence, and models of parallel computation. The research will involve both the development of algorithms specific to the SIMD and MIMD architectures and the use of these computers as compute servers over the departmental network. The next development in high performance computing will be high speed parallel processors. There are currently two main classifications of these processors. Single Instruction Multiple Data (SIMD) and Multiple Instruction Multiple Data (MIMD) processors. SIMD computers execute a single sequence of instructions on all of its processing elements. Each processing element may have different data that it is processing. A MIMD computer may have a different program running on each of its processing elements that may have their own data. In order to develop the software necessary to utilize these computers it is necessary to have in place software tools that support instrumentation, program development, and re-

source allocation. The development of such tools is supported by this infrastructure. It is also important to determine which problems run best on which type of processor. Thus these computers will be used in research in artificial intelligence, databases, and computer architecture in determining efficient algorithms for these problem domains. Finally, these computers are efficient numeric processors and will be used for both scientific computing and numeric optimization problems.

CDA-9123483

\$150,000—12 mos

Vitter, Jeffrey S.

Duke University

#### **Parallel Computing: Computational Theory, Scientific Applications and Systems Research**

This proposal supports the acquisition of a parallel computer capable of operating in both Single Instruction, Multiple Data mode and Multiple Instruction, Multiple Data mode. The computer will be used to support research in operating systems, scientific computing, parallel algorithms, VLSI design, and logic programming. Collaborations with other departments, particularly with computational physics and chemistry, will also be enabled by the acquisition of this computer.

CDA-9542697

\$76,897—12 mos

Vitter, Jeffrey S.

Duke University

#### **SIMD/MIMD Parallel Computing: Computational Theory, Scientific Applications and Systems Research**

Every year the Institutional Infrastructure program arranges a workshop for information sharing between its grantees. Each year, a different grantee institution volunteers to host the meeting. These meetings are very valuable since each meeting is the primary forum for exchange of research ideas, exchange of purchasing information and negotiation strategies, and exchange of information between CDA and its grantees concerning NSF programs and possible future opportunities to better serve the scientific community.

CDA-9504389

\$548,000—12 mos

Winner, Robert

Enterprise Computing Institute

#### **HyperEducation Consortium**

This cooperative agreement recommendation is for the Consortium for NII-Based Education, hereinafter referred to as the HyperEducation Consortium, with NSF acting as agent for ARPA in the Technology Reinvestment Program. The HyperEducation Consortium members are Enterprise Computing Institute, Inc., Digital Equipment Corporation, Digital Learning Services; and Aimtech. The proposal was reviewed by a multi-agency review panel in three stages. The first stage was a screen-

ing review by government program officers and knowledgeable government employees from interested agencies. The second review was of a collection of recommended proposals; a ranking of those proposals was put forward to an interagency review committee. This committee then chose the proposal that were to be negotiated and chose the agencies to act as ARPA's agent.

This TRP will be managed by a multi-agency team consisting of representatives from the RED Division of

NSF/EHR, the EISE Division of NSF/EHR, the CDA Office in NSF/CISE, the IRIS Division in NSF/ CISE, and a representative from ARPA's Computing Systems Technology Office.

This HyperEducation proposal was recommended for negotiation and NSF was assigned as the agent. Negotiations commenced and a cooperative agreement was successfully negotiated.

# CISE Institutional Infrastructure (Small Scale)

CDA-9216202  
\$200,000—12 mos  
Bruno, John L.  
University of California—Santa Barbara

## **An Infrastructure Facility for Parallel Processing**

This Institutional Infrastructure award is for the support of research projects in experimental and implementation aspects of distributed and parallel computing. The funds will support the acquisition of a parallel computer and for the support staff to maintain it. The research supported includes systems and programming issues for parallel machines, parallel algorithms, and dynamic visualization. The High Performance Computing, Communications and Information Technology initiative recognizes as important to the nations future the development of new architecture computers to solve problems which now cannot be solved on computers. This infrastructure award gives the University of California, Santa Barbara the equipment necessary to participate in this research initiative.

CDA-9540814  
\$62,975—12 mos  
Bruno, John L.  
University of California, Santa Barbara

## **An Infrastructure Facility for Parallel Processing**

The University of California, Santa Barbara received a 5-year Institutional Infrastructure award in 1993 to support the acquisition of a Meiko CS-2 parallel computer, and to enable research projects in experimental and implementation aspects of distributed and parallel computing. This supplement provides support for the purchase of 4 workstations compatible with the Meiko CS-2 scalar nodes but with large disks and an interconnection via a 155Mbit ATM network. Acquisition of the workstations will allow the investigators to examine the application of parallel algorithms developed on large parallel machines to networks of measurement, shaping and protocols, multi-dimensional index structure and content-based retrieval for image database. The investigators are working on two large-scale projects, one in the database area and one in distributed digital libraries.

CDA-9115428  
\$200,000—12 mos  
Dongarra, Jack J.  
University of Tennessee—Knoxville

## **An Experimental Research Facility for Parallel Computing**

The advanced Computing Laboratory in the Computer Science Department at the University of Tennessee has access to a number of new architecture high performance computers. This award is to upgrade the facility by the addition of a mixed mode Single Instruction Multiple Data (SIMD)/Multiple Instruction Multiple Data (MIMD) computer, increasing the number of processors in a shared memory MIMD computer, and providing partial support for a technician. The research supported by these computers include the design and development of portable, efficient numerical linear algebra algorithms; the development of non-numeric algorithms for parallel architectures; the development of parallel algorithms for genome sequencing; and the development of parallel discrete optimization algorithms using the genetic algorithm method.

CDA-9542990  
\$75,000—12 mos  
Dongarra, Jack J.  
University of Tennessee—Knoxville

## **An Experimental Research Facility for Parallel Computing Supplement: Message Passing Interface Forum**

This supplement is for the organization of Working Group meetings for the definition of a Message Passage Interface (MPI) standard. The meetings will formalize an MPI definition, develop extensions to the MPI definition, and involve the High Performance Fortran group in the development of standard.

CDA-9216321  
\$171,460—12 mos  
Horowitz, Ellis  
University of Southern California

## **The USC Experimental Networking Environment for Protocol and Database Research**

This award is for the acquisition of a network testbed for the experimental networking and distributed database research at the University of Southern California. The primary research activities are concentrated in two main areas: Network Control Protocols and Distributed

Databases. The main feature that these two diverse research areas share is a need to

- (1) solve problems involving multiple nodes,
- (2) complement existing modeling, simulation, emulation, and small scale implementations with multi-node prototypes,
- (3) isolate the resulting network from the campus production network, and
- (4) employ a support staff to maintain and operate the network.

The study of distributed networks is important because of the wide availability of inexpensive workstations that can be easily linked together. Not so easy is how to utilize these networks effectively. The study of network protocols is critical to this task as is the study of distributed databases. This award supports both areas.

CDA-9115434

\$127,280—12 mos

Huang, Thomas S.

University of Illinois at Urbana-Champaign

**Laboratory for High-Resolution Dynamic Image Processing and Visualization**

This infrastructure award is for the development of an Imaging Laboratory that supports research in both dynamic imaging and in the processing of imaging data. Specific research projects supported by this laboratory include studies of human visual perception, video compression, three dimensional motion analysis, image reconstruction, adaptive filtering, and stereo vision. The award provides four years support for both equipment and maintenance.

CDA-9115268

\$199,874—12 mos

Mantey, Patrick E.

University of California—Santa Cruz

**A Laboratory for Scientific Visualization and Experimental Machine Learning**

This infrastructure award is for the development of a visualization and machine learning laboratory. The laboratory consists of powerful graphics workstations, a parallel processor, a large file server, a fiber optics high speed data network, and support personnel to maintain the laboratory. The research supported by this equipment includes: statistical data analysis, pattern recognition, and machine learning; visualization of sample volume data; interactive steering of simulations; high speed switching; concurrent systems; and applications of electronic libraries. A major bottleneck to the utilization of scientific information is the massive amount of data now collected. Scientific visualization is the term that covers an emerging collection of new techniques for transforming multidimensional numeric data into understandable graphic images. These images can then be manipulated and explored by scientists and engineers who, sitting at

their workstations, create models and draw inferences from them. Machine learning includes a wide variety of techniques from the fields of pattern recognition, signal processing, statistical decision and control theory, and artificial intelligence that allow the machine itself to participate in the process of creating models and drawing inferences from data. It is anticipated that a new synergy between machine learning and scientific visualization will arise from this award and that substantial collaborations with scientists outside of the computer science department will occur.

CDA-9015667

\$154,133—12 mos

Masson, Gerald

John Hopkins University

**Facility for Experimental Exploration and Validation**

This infrastructure award is for the purchase of a network of high speed workstations. This network of workstations is to support research in artificial intelligence, programming languages, geometric computing, and fault tolerant computing. The artificial intelligence research is concentrated in four areas: machine learning, constraint satisfaction networks, parallel logic programming, and knowledge representation. The research in programming languages involves the translation of CCS specifications to an implementation language which provably implements concurrency and provably satisfies real time constraints. The research in geometric computing is focused on computing higher-degree curves and surfaces, alternate representations for curves and surfaces, efficient methods for representing geometric modes, and motion planning. The research in fault tolerant computing is concentrated on self-monitoring systems. Johns Hopkins University will use its infrastructure grant to improve the environment for experimental research in computer science, information science, and computer engineering. Artificial intelligence is the generic name given to computer based research on performing actions normally described as “intelligent actions.” Johns Hopkins researchers will explore learning and reasoning actions. Languages to instruct computers in their operations have been studied for many years. The goal of these languages is to succinctly describe the desired operation with as little error as possible. The programming language research at Johns Hopkins pursues this goal for systems that must respond in “real time”. Computers are used extensively in robots. In order for reasoning to be performed about the environment in which the robot resides, a mathematical model of that environment must be constructed. Johns Hopkins researchers will be studying how to construct and use better mathematical models. Finally, the network as a whole will be used as a test bed for algorithms to detect faulty computers or links on the network.

CDA-9015692  
\$177,267—12 mos  
Proakis, John  
Northeastern University

### **Research Instrumentation**

This Institutional Infrastructure award to Northeastern University is for the development of a networked environment of powerful workstations and servers linking the College of Computer Science and the Digital Signal Processing group in the College of Engineering. The infrastructure supports research in a number of areas, many of them collaborative. CDMA for mobile communications involves several activities including the design of pseudorandom sequences for minimizing communication interference, the design of efficient CPM signals with trellis coding, and determining the fundamental limits on the capacity of multiple user mobile channels. Research on neural nets involves both architectures for neural nets and learning algorithms. Communication network research involves studying protocols for communications in high speed LANs and MANs, bridging LANs, and packet radio networks. Research on more mathematical topics includes computational algebra and algebraic models for compiler correctness. Digital signal processing research involves studies of hearing, high order spectra, image processing, adaptive signal processing methods, and joint source coding theory. Signal processing is a natural collaborative area for computer scientists and electrical engineers. The replacement of analog techniques by digital techniques requires a much more intensive use of computation in order to interpret communications. The research supported by this infrastructure grant includes work on how to make local networks communicate well amongst themselves and other networks, the development of new algorithms to get rid of noise and to optimize the information carrying capacity of communications links, the development of algorithms that will allow networks of computers to work the same way as cellular phone networks, and more theoretical work in studying the mathematical underpinnings of learning, algebra, and compilers.

CDA-9216172  
\$134,706—12 mos  
Quinn, Michael J.  
Oregon State University

### **A Laboratory for Joint Research in Artificial Intelligence and Parallel Computing**

This Institutional Infrastructure award is for the support of research projects in artificial intelligence and parallel computing. The infrastructure consists of a parallel computer and the staff to maintain the computer. The projects supported by this award include learning algorithms, real time decision making, data-parallel compilers, and parallel programming support environments.

Parallel computers are research tools in two senses. The first is that they provide a substantial increase in computational power. The second is that they act as an experimental vehicle for new systems software that needs to be developed in order to use the computers effectively. This award addresses both questions. The artificial intelligence research needs the computing power while the compiler and support environment work needs the experimental vehicle.

CDA-9115021  
\$203,732—12 mos  
Sahni, Sartaj K.  
University of Florida

### **Laboratory for Parallel Processing**

The infrastructure award is for the acquisition of equipment to develop a laboratory for parallel processing. The major acquisition is a 64 processor MIMD (Multiple Instruction, Multiple Data) parallel computer and workstations. Research will be performed in software engineering, parallel algorithms and data structures, networks and simulation, computer vision, and database management systems. The advent of new architecture parallel computers has opened new areas of research related to the effective use of these computers. The MIMD computers work by allowing individual processors to operate on independent data streams. The discovery of algorithms to effectively use this type of architecture is a major research question crossing several disciplines. The parallel processing laboratory at the University of Florida is investigating several research topics ranging from experimental algorithm studies to computer vision applications. In particular:

1. The software engineering group is developing a parallel programming language environment to be used in the development of parallel programs in conjunction with a knowledge based development and maintenance environment.
2. The parallel algorithms group is concentrating on experimentally determining bottlenecks with both processor communication and input/output devices. The experimental results will be compared with theoretical models of performance.
3. The network and simulation group is using the parallel computer as both an experimental testbed for load balancing and other performance enhancing algorithms and as a computational resource to perform complex simulations.
4. The computer vision group is developing algorithms to utilize parallelism. There is a natural match between many vision applications and the MIMD architecture.
5. The database management group is designing algorithms to implement an object oriented semantic database model on a MIMD architecture computer.

CDA-9541265  
\$60,000—12 mos  
Sahni, Sartaj K.  
University of Florida

#### **Laboratory for Parallel Processing**

The University of Florida, Gainesville, received a 5-year Institutional Infrastructure award in 1990 which they used to purchase a 64 processor nCube hypercube parallel computer (MIMD architecture) and workstations. The nCube has enabled the University to perform research projects in software development and maintenance techniques for parallel processing systems, parallel algorithms and data structures, networks and simulation, computer vision, and database management systems.

This supplement provides support to purchase a MasPar 2 computer to study algorithms that are better suited to a SIMD architecture. Research projects that will be supported include electronic CAD, simulation of neurocognitive phenomena, parallel sparse matrix factorization, simulation of physical systems with a large number of molecules, parallel parsing algorithms, parallel sorting and selection, adaptive filtering of digital radiographs, parallel algorithms for de-noising functional MRI image sequences by multiscale analysis, nonlinear techniques on wavelet domains for compression/decompression of moving pictures, partial differential equations, and medical imaging problems.

CDA-9541895  
\$20,000—06 mos  
Sahni, Sartaj K.  
University of Florida

#### **Laboratory for Parallel Processing**

This REU supplement requests support for four students to work on research projects in computer vision, image processing, parallel computing, VLSI CAD algorithms, databases, computer graphics, computer networks and computer conferencing.

CDA-9015696  
\$58,532—12 mos  
Siegel, Howard

Purdue University Research Foundation

#### **Infrastructure for Parallel Processing Research**

This award provides support to develop computing infrastructure in the areas of parallel languages and compilers, automatic parallelization of algorithms, computer vision, and simulation and synthesis of digital devices. The infrastructure consists of a state of the art Single Instruction Multiple Data (SIMD) computer along with support staff to ensure that the computer hardware and software are properly maintained. The parallel languages and compilers for parallel computers research focuses on the problem of the dependence of efficient software on the underlying parallel architecture. This dependence

makes the development of portable software which is also efficient difficult and to date impossible. The research focuses on languages in which parallelism can be expressed free of architecture assumptions and compilers that will compile programs using these architecture free constructs into efficient code for specific parallel architectures. The automatic parallelization of algorithms research focuses on the problem of efficiently mapping algorithms to SIMD computers. The SIMD computer executes by having many processors execute the same instruction on different data. Thus the movement of data and the choice of which processors should execute an instruction is critical in order to obtain high performance. This research focuses on a software tool that can be adapted to a variety of SIMD architectures and which will perform the parallelization of algorithms to be used with these architectures. Computer vision and image processing have been ideal applications for SIMD computers because the processing of images can be broken down into the processing of sub-images, each sub-image algorithm being the same, followed by uniform data movement between processors. The computer vision research aims to develop a collection of algorithms for vision and image processing that will efficiently use the SIMD architecture. The research projects on the simulation and synthesis of digital devices use the processing power of the SIMD computer to perform tasks that would require supercomputer computational capabilities. These projects include the synthesis of digital diffractive elements and the simulation of the operation of semiconductor devices. The synthesis of digital diffractive elements, used in optics, requires substantial computational capabilities and input/output capacity (on the order of 10,000 hours on a VAX 780). Similarly the modeling of semiconductor devices requires substantial computational resources (the solution of order 30,000 sparse matrices). Both of these research projects propose to develop algorithms for use on the SIMD computer in order to obtain the computational capability necessary to solve problems of this magnitude.

CDA-9216171  
\$100,950—12 mos  
Wolf, Wayne  
Princeton University

#### **Experimental Facilities for Applications—Directed System Synthesis**

This Infrastructure Award provides computational infrastructure for use in the areas of video coding and image understanding and fast-turnaround system synthesis. The former research area requires massive data stores and special purpose video processors. The latter area requires fast simulations. The infrastructure provided under this award includes both the special purpose computational video equipment and storage devices and the high speed workstations necessary for both research areas.

Digital High Definition Television requires massive amounts of memory and substantial processing power. This infrastructure award is providing research equipment for investigations into digital video imaging and

processing. The award also provides for a collection of very high speed workstations for the rapid simulation of computer systems. This capability will allow these systems to be much more rapidly developed.

# CISE Institutional Infrastructure (Minority Institutions)

CDA-9313624  
\$199,167—12 mos  
Adjouadi, Malek

Florida International University

## **Institutional Infrastructure Minority Institutions Program: Establishment of an Institutional Infrastructure: Center for Advanced Technology and Education (CATE)**

This award provides infrastructure support for the development of research and educational activities in the Department of Electrical and Computer Engineering, and in the School of Computer Science at Florida International University. The management of the program will be by the Center for Advanced Technology and Education (CATE), a state of the art research facility to integrate critical technology areas in computer and information science and engineering. The projects will involve software engineering, computer vision, neural networks, artificial intelligence and robotics applications, and computer aided education. The unifying theme to the work will be concurrent processing. In the course of the projects both the graduate and undergraduate programs will be enhanced and revitalized.

CDA-9540729  
\$40,000—12 mos  
Adjouadi, Malek

Florida International University

## **Institutional Infrastructure Minority Institutions Program: Establishment of an Institutional Infrastructure: Center for Advanced Technology and Education (CATE)**

This REU Supplement to NSF CISE Institutional Infrastructure-Minority Institutions (II-MI) Grant, Establishment of an Institutional Infrastructure: Center for Advanced Technology and Education (CATE), supports the involvement of eight students selected to foment undergraduate research utilizing the infrastructure provided by the grant in the following projects:

- Image Processing
- Multimedia
- Robotics
- Biomedical Engineering
- Computer Networking
- Parallel Processing

Three faculty researchers will continue their involvement in these research areas and would monitor the se-

lected students who will in turn work their graduate colleagues.

CDA-9522157  
\$190,883—12 mos  
Alo, Richard

University of Houston-Downtown

## **CISE Minority Institutions Infrastructure: Improving Research and Undergraduate Education in Computer Science**

This award provides for infrastructure designed to substantially increase the numbers of minority students going into and completing degrees in the computing disciplines at the University of Houston-Downtown. The project has three primary components: Students, Academic Program, and Research with strong recruitment, mentoring, curriculum enhancement, and research development activities as parts of the project. Collaboration with Rice University has been established and will be an important part of the overall effort. Community college linkages will be initiated, a Saturday Academy for high school students has been established, research experiences for undergraduates will be expanded, and the faculty research environment will be enhanced. It is anticipated that this project has the potential to become a model for development of programs for minority success at other similar urban universities.

CDA-9114481  
\$228,043—12 mos  
Barba, Joseph

City College of CUNY

## **Center for Minorities in Information Processing Systems**

This grant provides infrastructure support for the development of the research and educational activities of the Center for Minorities in Information Processing Systems at the City College of CUNY. The support includes computing and VLSI laboratory equipment and software, undergraduate and graduate student assistantships, faculty release time, and student tutoring. The principal investigators will conduct research in (1) image analysis, (2) simultaneous projection algorithms for set-theoretic signal recovery, (3) automata, group representations, and Fourier transforms, (4) parallel algorithms for computer vision and Monte Carlo methods, (5) VLSI implementations, (6) a transformation kernel for parallel programming, and (7) image warping. Educational activities include the restructuring of special

sections of the first course in computer science as “collaborative learning communities” as part of an innovative approach to problem solving and software design.

CDA-9522207

\$280,346—12 mos

Bernat, Andrew

University of Texas, El Paso

**CISE Minority Institutions Infrastructure: Building Affinity Groups to Enable and Encourage Student Success in Computing**

This award provides infrastructure support for a program designed to substantially increase the number of minorities, particularly Hispanics, who complete degree programs in the areas of computer and information science and engineering. It involves both the Computer Science and Computer Engineering Departments at the University of Texas at El Paso (UTEP). The project is built around the concept of Affinity Groups, groups which are centered about a research area and which involve both graduate and undergraduate students and one or two faculty members at the center of each group. Within the groups, emphasis is on developing social and communication skills as well as on research and technical skills. A strong evaluation component is built into the project. It is anticipated that the structure developed has the potential to become a model for the success of minority students at a wide range of similar urban, commuter institutions.

CDA-9215983

\$208,681—12 mos

Ellis, Mary

Hampton University

**Hampton University Experimental Laboratory for Promoting Education and Research (HELPER)**

This award provides infrastructure support for the development of the research and educational activities of the Hampton University Experimental Laboratory for promoting Education and Research. The support includes computing resources, as well as awards to undergraduate and graduate students. The investigators will be conducting research in the areas of (1) high-speed/parallel computing, (2) software engineering, (3) computer graphics, and (4) artificial intelligence/expert system development.

CDA-9417659

\$228,627—12 mos

Espinosa, Ramon

University of Puerto Rico, Mayaguez

**Development of a Computer Engineering Research Environment at University of Puerto Rico, Mayaguez**

The ECE Department of the University of Puerto Rico at Mayaguez has a tradition of producing highly qualified Computer Engineering graduates with the neces-

sary skills, knowledge, and expertise to succeed in either graduate school of the industrial environment. Involving undergraduates students in research as; increased their enthusiasm and interest in their studies, provided them with additional knowledge and experience, increased their employment opportunities, and motivated them towards graduate school. Besides continuing this successful undergraduate research program, the major goal of this project is to develop the research environment needed to start a Ph.D. program in Computer Engineering and to increase minority participation in graduate school and research. To maintain an excellent research environment and to accomplish the CISE II-MI program’s goal of increasing minority participation the following activities are planned:

- to create a proposal, during the first two years, to establish a Ph.D. program in collaboration with the Math Departments of the Rio Piedras and Mayaguez Campuses;
- establish a plan to retain and increase minority participation; conduct research and establish a productivity plan for researchers;
- establish a plan for faculty development;
- acquire new research equipment; and
- establish a Computer Engineering Center to administer and coordinate the proposed activities

CDA-9522079

\$272,382—12 mos

Giguette, Marguerite

Xavier University of Louisiana

**Minority Institutions Infrastructure: Furthering the Goal of Increasing the Number of Minority Undergraduate and Graduate Students in CISE Disciplines**

This award provides support for a comprehensive program that will make substantial infrastructure changes to the computer science and related disciplines at Xavier University. The goals of the program are 1) to increase the number of majors in CISE disciplines by 50%, 2) to increase the number of CISE majors who go to graduate school by 100%, and 3) to expand the research activities of all of the CISE students and faculty. These goals will be addressed by revising and significantly expanding the current summer outreach programs, expanding the undergraduate research and mentoring programs, and establishing new teaching and research laboratories. This project builds on the very successful similar efforts in the health sciences at Xavier. It is anticipated that comparable results can be achieved in the computing disciplines as well and that the model developed in this project has the potential to become a national model for minority student success at other similar institutions.

CDA-9313299  
\$161,429—12 mos  
Harmon, Marion  
Florida A&M University

**Institutional Infrastructure Minority Institutions Program:  
Software Engineering Research and Education Laboratory**

This award provides infrastructure support for the development of research and educational activities in the area of software engineering in the Department of Computer Information Systems at Florida A&M University. Included in the program is a research productivity enhancement component, a computer facilities enhancement component, an instructional program enhancement component, and a student success assurance component. The program will improve the research productivity and instruction effectiveness of the department resulting in an increase in the number of minority students entering graduate programs and the computer science field.

CDA-9522067  
\$43,992—12 mos  
Marshall, Roger  
Winston-Salem State University

**Minority Institutions Infrastructure: Project RAISE—One  
year Planning Grant**

This is a Planning Grant to develop a five year continuing grant proposal under the Minority Institutions Infrastructure (MI-I) program. The institution plans to develop activities which are part of their long range plan, Project RAISE, Research Advancement in Science Education. As a part of these activities, a proposal for a five-year continuing grant will be developed. Winston Salem State University is one of sixteen institutions comprising the University of North Carolina System. It is a predominately African-American undergraduate institution serving the educational needs of Winston-Salem and the northwest Piedmont area. There are currently 226 students majoring in computer science and the project, if successful as a five-year proposal, has the potential ultimately to significantly increase the number and quality of students graduating in computer science.

CDA-9417362  
\$142,123—12 mos  
Moreno, Oscar  
University of Puerto Rico, Rio Piedras

**Infrastructure for Computer Science Research in Puerto  
Rico**

The Mathematics (and Computer Science) Department of the University of Puerto Rico at Rio Piedras has an excellent record of research accomplishments in the areas of computational and computer science, while the ECE Department at Mayaguez has been producing highly qualified students in the areas of computer engineering. It is expected that the collaboration of these two departments through faculty and student encoun-

ters will provide a research environment to substantially increase the number and quality of students. The major goal of this project is thus develop the research environment needed to start a Ph.D. program in Computer Science and to increase minority participation in graduate school and research. To maintain an excellent research environment and to accomplish the CISE II-MI program's goal of increasing minority participation the following activities are planned.

- to create a proposal, during the first two years, to establish a Ph.D. program in collaboration with the Mathematics and ECE Departments of the Mayaguez Campus;
- establish a plan to retain and increase minority participation; conduct research and establish a productivity plan for researchers;
- establish a plan for faculty development;
- acquire new research equipment; and
- establish and strengthen a Computer Science program.

CDA-9114359  
\$109,058—12 mos  
Warsi, Nazir  
Clark Atlanta

**CAU Computing Science Research Laboratory (CSRL)**

This grant provides infrastructure support for the development of the research and educational activities of the Computing Science Research Laboratory (CSRL) at Clark Atlanta University. The support includes computing equipment and software, graduate student assistantships, faculty release time, and the NSFnet connection. The principal investigators will conduct research in (1) software reuse, (2) interactive multimedia systems, (3) object-oriented databases, (4) parallel algorithms for network dynamic programming, (5) neural network implementations, and (6) parallel algorithms for roots of polynomials. The educational component of this project blends undergraduate and graduate research experiences at CSRL with an existing educational program funded through ONR which exploits linkages with local universities, industry, and national laboratories.

CDA-9417390  
\$259,237—12 mos  
Wetherbee, Ted  
Fond du lac Tribal College

**A Cooperative Learning Environment that Fosters the  
Pursuit of Scientific Careers for American Indians**

This project proposes to significantly increase the number of American Indian students attaining four year and graduate degrees in computer science and engineering, FDLTCC and Fond du Lac Ojibwe School (a tribal K-12 institution) will hold summer camps for American Indian youth in grade 5-8, and bridge-to-college camps for grades 9-12, to study interesting, engaging

computer science activities and applications. They shall also study traditional Native American view of the world—not to abandon standard Western scientific methods, but to examine fresh approaches to problem solving. FDLTCC will create a lower division computer science program designed specifically to support and encourage American Indian students through successful transfer to a four year institution to complete their upper division CISE studies. Formal mentoring and curriculum designed to encourage performance in a cooperative manner will characterize the tribal college program. This model, cultivating interest in CISE work among American Indian youth, supporting the bridge from K-12 schools to the tribal college, strongly supporting American Indian students in lower division CISE studies, and supporting students through transfer to high quality four year computer science programs, is designed

to be attractive and applicable to tribal K-12 schools and colleges governed by sovereign tribal nations which are the key education providers for American Indian youth living on or near tribal lands.

CDA-9541299

\$134,200—12 mos

Wetherbee, Ted

Fond du Lac Tribal College

**A Cooperative Learning Environment that Fosters the Pursuit of Scientific Careers for American Indians**

This is a supplement to the original Infrastructure grant to the Fond du Lac Tribal & Community College. The supplement will provide funds for acquisition of 24 workstations to be utilized first in their summer 1995 Institute and then throughout the remaining years of the five year continuing grant.

# CISE Educational Infrastructure

CDA-9522537

\$465,649—36 mos

Arnow, David M.

CUNY, Brooklyn College

## **CISE Educational Infrastructure: Distributed Processing Across the Undergraduate Computer Science Curriculum**

This project incorporates advances in distributed processing research into the entire undergraduate computer science (CS) curriculum, starting from CS 1. This involves constructing a vertical integration of this new programming methodology. As a result, (1) every student in CS will be acquainted with distributed processing; (2) students will have time to absorb key ideas introduced in elementary courses and these ideas will be reinforced in advanced courses; (3) the theory and techniques of distributed computing can be presented as the students' readiness permits and as appropriate applications are encountered in the curriculum. At the outset, short modules addressing distributed computing issues will be incorporated into the two beginning programming courses. Subsequently, additional modules will be included in the discrete mathematics course, the shell programming course, and the operating systems course. Advanced courses will integrate distributed computing as part of the student's standard CS toolkit. Special topics courses, oriented towards challenging applications, will be revised to exploit the students' training. In the third year of this effort, a faculty development workshop for CS faculty from around the country will be organized in order to disseminate the results of this effort.

CDA-9543067

\$1,307—6 mos

Gries, David

Cornell University

## **CISE Educational Infrastructure: Revitalizing the Computer Science Curriculum**

The award of this supplement will enable the PI to go to Ireland for a conference, the 9th International Conference of the Z Users, where Professor Gries will be an invited guest speaker to talk about his approach in teaching logic. He will also give a tutorial on this subject at the conference. In addition, when in Ireland, he has been invited to give a similar talk to the annual meeting of the Irish Mathematical Society. His talks are all in the

area relating to the revitalization of computer science curriculum which was funded by this grant. These talks will serve as a part of the dissemination plan of the project.

CDA-9543020

\$10,000—6 mos

Guha, Ratan

University of Central Florida

## **Parallel Computation in the Undergraduate Computer Science Curriculum**

The award of this supplement will enable the University of Central Florida partial support a two-week residential workshop and conference on parallel computing to be held from May 22 through June 2, 1995. The workshop is designed for people in academia and industry, who would like to acquire knowledge in parallel computing and in pedagogical techniques useful for conveying this knowledge to others. The workshop will provide an overview of parallel computing with emphasis on programming and applications. Special attention will be given to the introduction of parallelism into the existing curricula. The last two days of the workshop will be a conference devoted to presentations of experiences of teaching parallel processing to undergraduates. Participants will have hands on experience on BBN GP1000 with 160 processors, a DECmpp 12000 with 8192 processors, and distributed computing using networks of workstations, all located within the Parallel Computation Center at the University of Central Florida.

CDA-9522319

\$356,067—36 mos

Jain, Raj

Ohio State University

## **CISE Educational Infrastructure: Laboratories for Data Communications and Computer Networks**

A laboratory-oriented hands-on curriculum for data communications and computer networking will be developed. This will enable students to experiment with various communications/telecommunications and networking concepts using a workstation, a PC, or a network of workstations. They will be able to design new protocols, verify them using protocol engineering tools, implement them, and visually see the impact of their actions. Data message flows, packet losses, control/rout-

ing message flows, virtual circuit setups, link failures, bit errors, etc. will be seen by the students at a slow (visible) speed. Multimedia and sound effects will be used to show abnormal conditions such as errors and losses. Various nodes of the simulated network will be programmable to run automatically or be under manual control of students. The manual control will allow the students to see the effect of unpredictable actions.

The major features of this project include the following: 1) Hands-on laboratory-oriented curriculum requiring students to develop protocol modules and experiment with their designs. 2) Integration of traditional concepts. 3) Use of a distributed gaming/simulation environment to allow experimenting with unpredictable behaviors. 4) Use of multimedia visual techniques to show the effects of various actions 5) Application of protocol engineering principles to protocol development.

CDA-9522265

\$373,524—36 mos

Maurer, Peter M.

University of South Florida

#### **CISE Educational Infrastructure: Incorporating Design and Design Automation into the Undergraduate Computer Science Curriculum**

This project is to enhance the quality of undergraduate courses by incorporating new research in hardware design, and design automation software. Three new courses will be introduced, and a fourth is being planned. Three existing undergraduate hardware courses will be revised to include new information on the use of design tools, and design automation theory. The first objective is to teach students how to use design tools, while the second is to teach students how to actively participate in the development of new tools. The final products will be a set of course outlines with detailed guidelines and design-oriented exercises; a set of laboratory manuals providing exercises in creating complex designs and making modifications to existing designs; a set of complex designs to be used either as examples or as the basis for exercises in design modifications; a set of highly

sophisticated and completely integrated design tools that will carry the student from the initial inception of an idea through to its implementation; and a set of new textbooks aimed at the problems of design and the use of design automation. Results will be made available through scholarly publications, Internet newsgroups and anonymous FTP, and through a series of summer workshops.

CDA-9522257

\$257,460—36 mos

Sobel, Ann E.

Miami University

#### **CISE Educational Infrastructure: Integrating a Formal Method into the Software Engineering Curriculum**

This project is to integrate a formal method into a software engineering curriculum. The formal method chosen captures the external behavior of a system component while supporting both the compositionality of component specifications and the hierarchical decomposition of a system specification. The method will be introduced by a sequence of courses, beginning in the sophomore year, after two semesters of programming and one semester of discrete math.

The first course will address the basic skills needed to apply formal method techniques and will not be coupled to any implemented language. The next course will apply the method to a particular programming language and the third course will extend the concepts to the analysis and design phases of the software life cycle. The last course in the sequence will address concurrency in depth. Finally, students will test the efficacy of their modified curriculum through an existing project-oriented senior capstone sequence.

The project will be managed, monitored, and assessed by an advisory council, which will include members of the project and external consultants. The curriculum format, the evaluations used, and the final results will be made available to the academic community through publications and presentations.

# Academic Research Infrastructure

CDA-9512454

\$267,000—36 mos

Adjouadi, Malek

Florida International University

## **Acquisition of Equipment for Integrated Sensing Towards Real-Time Vision, Cognition and 3-D Modeling**

This proposal requests a confocal microscope, a high-speed video motion analyzer, and two dedicated processors which will complement the existing Onyx multiprocessing supercomputer with four R8000 RISC processors. The integrated equipment will bring new research dimension in real-time vision, cognition, and 3-D modeling with real-world applications. Research collaboration has been established with Coulter Corporation in analysis and classification of blood cells, with Baptist Hospital of Miami in surgical planning and nuclear medicine, and with the University of Florida's Center for Intelligent Machines in robot vision, motion analysis, and telerobotics. New visual/sensing techniques will be developed and used in these projects for high sensitivity and resolution, real-time motion analysis, real-time 3-D rendering and visualization, and on-chip 3-D surface reconstruction and depth extraction.

CDA-9512272

\$814,000—36 mos

DeFanti, Thomas A.

University of Illinois, Chicago

## **Development of Instrumentation for Shared Virtual Prototyping: The Immersa Desk and NII/Wall**

The main focus of the proposed project is to create virtual-reality and virtual-prototyping instrumentation for viewing scientific and engineering data. The University has been involved in an ongoing development of the CAVE virtual-reality theater, a room-sized, high-resolution, projection-based system that enables users to experience good immersion in full 3D imagery. The goal of this proposed project is to broaden the scope for making the CAVE both smaller and larger. A smaller, software compatible, drafting-table format version, called ImmersaDesk, is being designed. It uses a high-end graphics system and projector for each ImmersaDesk, and an ATM gear to allow remote ImmersaDesk to ImmersaDesk collaborative design sessions.

A larger high-resolution (1600 x 2048) stereo screen, called NII/Wall is being developed for large audiences. The NII/Wall will serve as a portal into networked scal-

able computers located around the country so scientists and engineers can interact with simulations running on distributed clusters of shared-memory processors.

CDA-9512241

\$888,925—36 mos

Henderson, Thomas C.

University of Utah

## **Acquisition of Computational Steering Instrumentation**

The proposed project is to acquire an SGI Power Onyx graphics engine front end, and a SGI Power Challenge computational engine for large-scale computational steering. Computational steering permits users to interactively change boundary conditions, model geometry, and computational parameters via a graphical user interface. It allows the visualization to guide or steer the design and computation phases of the simulation or computation. The computational steering model is applicable to a wide range of applications including medicine, genetics, image analysis, CAD/CAM, telerobotics, and virtual reality. Software is being developed in different application areas to "close the loop" to replace the typical simulation model in which the user manually sets input parameters, computes results, stores data, visualizes the results via a separate visualization package, and then starts again at the beginning. The proposed equipment will permit interactive modeling and scientific visualization supported by parallel computational systems.

CDA-9512621

\$390,276—36 mos

Ja Ja, Joseph F.

University of Maryland, College Park

## **Acquisition of an Network**

The project proposes to establish an ATM-based high speed communication network connecting six research laboratories to the UMIACS Parallel Processing Laboratory (PPL). The six laboratories reside in the Departments of Computer Science, Geography, and Physics, and the Institute of Physical Science and Technology. The proposed network will consist of seven ATM local area networks connected by multimode fiber to four additional switches managed by the campus Computer Science Center. High-speed off-campus connections will be established to SURAnet and the NSF-funded National Scalable Cluster Project (NSCP). The UMIACS PPL provides approximately 20 Gigafllops of computational

power and 400 Gigabytes of online disk storage to these laboratories.

The proposed network will serve as a research instrument for addressing critical issues in networking research, operation and management network computing using distributed shared memory, distributed multimedia databases, and scalable I/O. The network will substantially enhance a number of collaborative research activities including (1) the development and evaluation of transport layer services over ATM LAN's, (2) the development of methodologies and tools for creating wide-area DSM, (3) experimental high energy physics requiring statistics-intensive data analysis, (4) visualization in scientific computations for chaotic dynamics and computational mechanics, (5) the application of remotely sensed images in the analysis of the Earth's environmental systems, and (6) techniques for creating and manipulating multimedia databases and scalable parallel I/O.

CDA-9512266

\$249,099—36 mos

Jordan, R.G.

Florida Atlantic University

#### **Acquisition of High-Performance Graphics Supercomputer for the College of Science**

The proposed project is to provide a central, high-performance, and network-based computational facility with high-quality graphics, visualization and animation capabilities for the needs of faculty and graduate students in sciences. The facility supports a large number of diverse research projects in scientific and mathematical disciplines. Four general types of research are identified, namely: (1) compute-intensive, (2) algorithm development and applications, (3) data analysis, visualization and animation, and (4) modelling simulation. The computational environment encourages an interdisciplinary approach which brings together the common elements of research projects in the Departments of Physics, Chemistry, Mathematics, Geology and the multidisciplinary Center for Complex Systems. An important consequence of the proposed project is that it will not only enhance the current faculty and student research and education but that it will act as a catalyst for new collaborations with the College of Science.

CDA-9502957

\$500,000—24 mos

Levine, Michael J.

Carnegie Mellon

#### **CISE Research Infrastructure: Cooperative Teraflop Infrastructure for Grand and National Challenge (ARI)**

The proposed project is to add additional hardware infrastructure to provide low latency and high bandwidth connectivity between the vBNS and supercomputers at each supercomputing center. It will also connect network-attached disk arrays to provide very short term storage buffering for running the distributed applications.

These added components will integrate the four independent supercomputing centers into a single distributed teraflop computing facility. This integration will provide a testbed for a number of development and development projects in applied computer science and computational sciences.

CDA-9512448

\$195,671—36 mos

Mataric, Maja J.

Brandeis University

#### **Acquisition of Research Infrastructure for Autonomous Robotics**

The proposed project is to establish and support a new laboratory for adaptive behavior which will be equipped with mobile robots; and the computational, electronic, and mechanical equipment. The laboratory supports interdisciplinary research involving engineering and cognitive science in behavior and learning on autonomous agents. Studies to be carried in areas of directed and emergent programming, reinforcement learning, neural network learning, and evolutionary and genetic programming approaches. A set of related research projects in multi-agent and multi-robot will be initiated for dealing with a variety of agents, environments, and tasks; for selecting control strategies; and for simplifying the task of designing complex multi-agent systems. The laboratory will also be used for student projects in advanced computer science courses.

CDA-9512540

\$314,500—36 mos

Mathys, Peter

University of Colorado, Boulder

#### **Acquisition of Instrumentation for Research in Radio Frequency Wireless and Mobile Data Communication Networks**

The proposed project requests major research instrumentation which consists of an RF channel simulator; microwave equipment for frequencies up to 40 Ghz including a spectrum analyzer, mixers, phase shifters, etc.; a frequency agile signal simulator; spread spectrum modems, fast A/D converters, fast DSP boards, and three workstations with simulation software. The equipment supports research and education in wireless and mobile communications. Planned research projects are in areas of channel modeling, microwave transmitter and receiver design and implementation, design and analysis of new modulation methods including transmission and reception diversity, implementation of novel concepts of detection, equalization and demodulation, design of multi-access protocols, and adaptation of routing and flow control algorithms for wireless environments.

CDA-9512507

\$1,681,175—36 mos

Messina, Paul

California Institute of Technology

**Acquisition of CAPRI: CSCC Archival and Parallel Resource Interface**

The Concurrent Supercomputing Consortium (CSCC) which is led by the California Institute of Technology proposes to acquire a large-scale data storage facility with a parallel I/O architecture and integrate it with the consortium's existing computing resources. It will undertake a CSCC Archive and Parallel Resource Interface (CAPRI) project which will enable new, data-intensive applications to be carried out. The facility will provide the ability to store terabytes of data and to access the storage system with multiple parallel interfaces. It will serve as a key research instrument for the scalable I/O research initiative. The results of the research project will enable the scientists at the Consortium to achieve unprecedented performance on data-intensive computational problems. The project will greatly enhance the Consortium's computing environment by creating storage capability commensurate with the prodigious ability of the computational resources to generate data.

The major components of the proposed system are (1) the high-performance storage system (HPSS) software package, (2) a 64 Gigabyte on-board disk cache, (3) 16 HIPPI nodes for supporting parallel network I/O, (4) 80 Gigabytes of RAID disk caches, (5) a 15 Terabyte archival storage system including four IBM 3490-C2A tape drives and robotic tape handling, and (6) a HIPPI switch.

CDA-9512270

\$125,918—36 mos

Nicol, David M.

College of William & Mary

**Acquisition of a Parallel Graphics Computer for Inter-Disciplinary Computational Science Research**

The proposed project is to acquire a parallel graphics computer, a Silicon Graphics Onyx symmetric multi-processor, that will support a wide variety of computational science research activities. This computer will provide a focal point for the initiation of new inter-disciplinary research in computational fluid dynamics, flow visualization, materials science, geophysics, and parallel algorithms for the simulation and analysis of complex discrete systems in addition to supporting existing research. This computational science environment will have the following joint attributes: (1) a parallel architecture of basic research interest to computer scientists, and (2) memory, computational power and sophisticated high-speed graphics capabilities sufficient to support the contemporary computational and data visualization requirements of physical scientists.

CDA-9512210

\$985,000—36 mos

Oden, J.

University of Texas, Austin

**Acquisition of Major Research Instrumentation for an Experimental Parallel Computing Facility**

This proposal requests the acquisition of a mid-scale parallel computing system consisting of 32 to 64 processing elements with high bandwidth interprocessor communication to insure scalability into the teraflop regime. The system will have parallel I/O to a disk system of around 100 gigabytes capacity. The facility will provide for the development of new computational algorithms, new software tools and mathematical techniques which will have a broad impact across a multitude of scientific and engineering disciplines. The proposed facility supports broad research activities across a variety of disciplines in engineering and sciences, in such tasks parallel computing play an important role. These research activities span the entire spectrum of computational modeling, ranging from computational chemistry to engineering mechanics, and to astrophysics.

CDA-9512376

\$159,740—24 mos

Pahlavan, Kaveh

Worcester Polytechnic Institute

**An Experimental Wireless Network with ATM Connectivity**

The proposed project is to develop an experimental wireless network with ATM connectivity for multi-media applications. An experimental wireless campus test-bed will be used to construct a wireless classroom environment. In this classroom environment, the instructor presents his/her lecture material that is prepared on a personal computer through the electronic projector and an electronic board. Multi-media services including voice, text, and bit-mapped images will be provided to students dispersed over a small geographical area on the campus. The results of the experiment will have a multifold impact including the feasibility of access multi-media information using portable wireless terminals, the development of benchmarks specific to multi-media wireless network applications for future comparative performance evaluation of different wireless technologies, and the development of multi-media wireless networking protocols and mobility management algorithms.

CDA-9512332

\$551,010—36 mos

Rowe, Lawrence A.

University of California, Berkeley

**Acquisition of Digital Media Storage and Networking Hardware**

The proposed project is aimed to build a hierarchical storage system for large multimedia objects and a high-speed network that can deliver these objects to desktops and classrooms across the campus. The storage system

will have the capacity of storing over 10,000 hours of digital video material, 100 million images, or a combination of video and images. The network will be able to deliver 100 concurrent digital media streams. In addition to serving the campus, research will be carried on the system itself which will include developing: (1) metadata databases that contain indexes to multimedia data and algorithms to create the indexes, (2) applications to query, access, deliver, and display digital video clips, (3) video compression and flow-control algorithms that support delivery of scalable compressed video on ATM networks, and (4) network protocols to deliver real-time continuous media streams to one or more destinations. The proposed storage system will be widely used on campus for research and education source materials. The system will be used to conduct moderate-sized experiments to determine the cost, effectiveness, and problems that associated with the use of the storage and network technology.

CDA-9512356  
\$489,600—36 mos  
Vitter, Jeffrey S.  
Duke University

#### **Acquisition of a Workstation Cluster Testbed for Next-Generation Collaborative Computing**

Duke University proposes the establishment of an ATM-based network cluster of high-performance 64-bit workstations for supporting collaborative research and applications. Three fundamental systems performance concerns are considered for supporting a wide mix of workloads and applications of these collaborative activities: locality management, resource conflicts,

and resource reduction. Seven specific projects have been identified: (1) toolkits and interfaces for explicit control of disk resources, (2) parallel file system, (3) virtual memory support for memory-intensive computations, (4) distributed shared memory, (5) cluster virtual storage, (6) data compression, and (7) predication for locality management. The workstation cluster instrumentation is necessary to perform state-of-the-art experimental research on methods to make the cluster viable for next-generation collaborative computing. The proposed cluster testbed is indispensable for conducting the research. The instrumentation is both the vehicle for and the subject of research.

CDA-9512191  
\$1,642,149—36 mos.  
York, Donald G.

University of Chicago

#### **Hardware Procurement and Software Development for a Multi-Institutional Mass Storage Systems**

The proposed project requests a terabyte storage system from 35 to 100 terabyte capacity over a high performance network. The proposed system is a high performance research infrastructure for high speed remote access to multi-terabyte databases. It will be shared by scientists in several diverse disciplines including research in climate studies, turbulence, cosmic ray air showers, and x-ray crystallography with the advanced photon source. All these tasks require terabyte databases. The proposed project is a collaboration between the University of Chicago, Argonne National Laboratory, IBM, and Ameritech.

# Combined Research-Curriculum Development Program

CDA-9527459

\$197,784—24 mos

Knapp, Benjamin R.

San Jose State University

## **The Human-Computer Interface**

This award will allow San Jose State University to develop a two course sequence in the field of Human Computer Interfaces (HCI). These courses will be project-oriented and taught in a lecture/laboratory mode. The projects, along with much of the course content, will be based on the research being performed at the San Jose State University in the HCI areas of biosignal input, sound localization, sonification and visualization. The lectures will cover subjects from pattern recognition to non-linear filtering to graphics algorithms.

The laboratory projects will be developed by the course instructors with the close assistance of the Department of Occupational Therapy, and the Computer Art and Design Center (CADRE). Project teams of engineering students will be augmented by “clients” from these departments who will define the requirements for the projects and evaluate each team’s progress toward success.

These courses will be taught at San Jose State University and at the University of California, Santa Cruz, via the new CALREN interactively networked teaching facility. Once the course has been fully developed, sites across the Silicon Valley will be able to present these courses.

CDA-9527537

\$289,291—36 mos

Rappaport, Theodore

Virginia Polytechnic Institute and State University

## **Curriculum Innovation for Simulation and Design of Wireless Communications Systems**

This award will allow the Virginia Polytechnic Institute and State University and the University of Missouri-Rolla to develop and distribute a trilogy of electrical engineering courses at the senior/graduate level. These courses include hardware and software components, combined with a change in teaching emphasis, and they will be offered at both universities, as well as at the University of Canterbury, in Christchurch, New Zealand. This project includes plans for the faculty to develop teaching materials, software modules, educational videotapes, and to provide laboratory/hardware experiences for students that do not exist today. Using an advisory panel consisting of academic and industry experts from the communications field, the course trilogy will be reviewed and perfected during this curriculum development. Materials developed under this program will be made available to universities throughout the country, through widely available texts, software modules, experiment study guides, and world-wide web postings.

# CISE Postdoctoral Research Associates

CDA-9504293

\$46,200—24 mos

Brooks, Frederick P.

University of North Carolina, Chapel Hill

## **CISE ES Postdoctoral Associate: Design of a Real-time, Fully Interactive Interface for Scanning Probe Microscopes**

One of the most promising capabilities of modern Atomic Force Microscopes (AFMs) is the ability to measure surface properties (such as conductance) along with topographic information. It is an open question how best to display multiple properties simultaneously to the user. Possible representations include surface color, transparency and shininess; sound modulated by the value of the property; and various force parameters, such as surface texture and stickiness. In this project subjects such as which channels are best for conveying which parameters and how many channels can independently carry information will be investigated.

Various physical and virtual hand-held tools to see which is most useful will be studied. This is similar to a carpenter who has various tools for cutting, smoothing and engraving. So might a surface scientist want different tools for different tools for different tasks. Working with surface scientists, which tools and visualizations are most effective can be determined. A new and more powerful interface to AFMs will be designed and built.

CDA-9503996

\$45,628—24 mos

Brown, Christopher M.

University of Rochester

## **CISE Postdoctoral Program: Real-time Viewpoint Control, Modeling and Reconstruction**

In this project the effort will be concentrated on (1) building an active vision system that uses PUMA or SARCOS manipulators to control the camera's position, and (2) using and extending existing techniques for recovering shape from images of a curved object's occluding contour. Because the camera moves around the object in a continuous fashion, camera position control and model-building will be modeled as two continuous, interdependent processes that occur simultaneously and operate in real-time.

The work on camera position control will focus on controlling the camera's position in real-time, and on imposing as few camera and manipulator calibration requirements as possible. The work on model-building will focus on developing real-time curve tracking meth-

ods that can handle the connectivity changes of occluding contour curves, and on implementing and evaluating existing shape-from-contour techniques.

This research will provide a better understanding of the practical issues in moving a camera to build models of curved objects with complex surface geometry.

CDA-9503966

\$46,200—24 mos

Gannon, Dennis B.

Indiana University, Bloomington

## **CISE Postdoctoral Program: Parallel Programming Archetypes for Scientific Computation: The MetaText Project**

The focus of this work is to apply the concept of program archetypes to the design of an Internet based electronic textbook on parallel programming techniques. An archetype is an abstraction that captures the common structural, computation, and communication features of a set of algorithms. This concept, when embedded in an interactive hypertext environment, provides a new approach to teaching about parallel programming as well as a software engineering foundation for deriving new parallel programs from existing applications.

The archetypes work will be expanded to include new areas of application study, including sparse matrix computation in adaptive finite element problems as well as parallel algorithms in computational cosmology. A second aspect of this project is to help integrate the work of these application scientists and of the Indiana MetaText research team that is building electronic textbook software. The goal is to build a MetaText archetype encyclopedia for parallel programming.

CDA-9505631

\$34,898—18 mos

Gribskov, Michael

University of California, San Diego

## **CISE Postdoctoral Program: Macromolecular Pattern Recognition**

This award is a postdoctoral associateship award to Dr. Michael Gribskov. The postdoctoral associate is Dr. Stella Veretnik and she will carry out computational biology research in macromolecular sequences and structures.

CDA-9503992  
\$45,903—24 mos  
Hollis, Ralph

Carnegie Mellon University

**CISE Postdoctoral Program: Distributed Real-time Control for Rapidly Reconfigurable Manufacturing**

The objectives of this project are: (1) providing the postdoctoral research associate with a rich environment for extending previous work in distributed real-time control of dynamic systems to the problem domain principally of manufacturing automation; (2) to contribute in the area of distributed control to the developing project in miniature factories, and (3) to provide a means for the associate to broaden the exposure to a wide variety of research topics within several units of the university.

Given the relatively constant cost of mechanical actuators and mechanisms in contrast to the continuing advances in price, size, and performance of computers it is inevitable that computational processes become as pervasive and distributed as their mechanical counterparts. The intent of this research project is to begin exploration of scientifically grounded approaches to the construction of such systems. Specifically, distributed real-time control systems will be constructed primarily to support a highly modular (in mechanical hardware, computational hardware, and software) miniature assembly system. The proposed controller architecture makes use of an event driven model for parallel processing to afford the necessarily high levels of software and hardware modularity, both of which will allow for rapid and efficient system development and reconfiguration without risking catastrophic failure due to unforeseen computational hardware or software interactions.

CDA-9504064  
\$46,200—24 mos  
Leveson, Nancy G.

University of Washington

**CISE Postdoctoral Program: ES Postdoctoral Associate: Safety and the Human-Computer Interface**

Two aspects of the integration of HCI and safety research will be investigated in this work. The first area of research is the application of HCI techniques and knowledge to the design of formal specification languages---both their printed and automated representations. The concept of semantic distance for formal specification languages will be made operational and its implications in the design of such languages will be explored. The approach will involve working with application experts in building real specifications and using this experience to determine what features of specifications they find most natural, and exploring cognitive psychology models of human error and how they can be applied to specification languages to minimize the errors that are made.

The second research topic involves modeling the HCI and performing a hazard analysis on the model. This work will involve modeling human behavior, developing analysis techniques to identify potential hazardous

behavior of both the human operators and the computer, integrating these models into the general model for specification and analysis of critical system properties, and determining how the resulting information can be used in the design of the software and the design of user procedures. The subject of how current knowledge about the safe design of traditional controls can be applied to the design of computer-based models will be examined and experimental testbeds will be developed to test the hypotheses.

CDA-9504288  
\$46,200—24 mos  
Mairson, Harry G.

Brandeis University

**CISE Postdoctoral Program: Computational Efficiency of Optimal Reduction in Lambda Calculus**

The goal of this research is to investigate the computational resources required to implement correct, optimal evaluation mechanisms for the lambda calculus. Because lambda calculus is a foundation for the design and implementation of programming languages, such research could contribute to the understanding of programming language implementation. Moreover, it would integrate approaches to computation that emphasize semantic issues as well as those of computational complexity.

The solution to optimality proposed by Gonthier, Abadi, and Lévy will be analyzed. The computational correctness of this scheme in an elementary, first-principles sense will be established and its computational complexity will be analyzed. Ultimately, a version of a correct evaluator whose complexity is polynomial in a reasonable cost model for lambda calculus will be put forward that the lambda calculus may be regarded as a “first class” formalism in the sense of the invariance thesis, the computationally efficient version of the Church-Turing thesis. The static semantics as a possible foundation for a lazy environment model will also be investigated.

CDA-9503968  
\$46,200—24 mos  
Moody, John

Oregon Graduate Institute

**CISE Postdoctoral Program: Robust Forecasting with Neural Networks**

In this project robust artificial neural network (ANN) learning algorithms and tools for forecasting time series, with specific applications to financial and economic time series will be developed. These algorithms and tools are difficult to predict due to the non-normal distribution of the noise and the presence of outliers, as well as the nonstationarity of both noise and signals. They thus make excellent benchmark problems for robust nonlinear modeling techniques.

In robust models, robust error measures for gracefully handling outliers in the data will be incorporated.

Also, a new method for automatically regularizing (constraining) the ANN model during training by using second order statistics of the cost function gradient. This prevents the network from adapting to noise and thus produces robust models.

In the area of learning algorithms, the application of a new simulated annealing type learning algorithm to recurrent networks will be investigated. It is believed that, based upon past experience with feedforward networks with many hidden layers, this algorithm will improve the performance of recurrent networks.

In variable selection, a novel use of Genetic Algorithms (GA) in combination with ANN models to select optimal subsets of variables for solving a problem will be pursued. Combining GAs with a newly developed statistical test, the so-called delta-test, into a more powerful tool for determining the optimal variable subset will also be done.

CDA-9504054

\$46,200—24 mos

Poggio, Tomaso

Massachusetts Institute of Technology

**CISE Postdoctoral Program: Complexi of Learning with Applications to Natural Language**

The research project consists of three parts. First, the investigator plans to sharpen the tools to analyze the sample complexity question—how many examples does the learner need to generalize well? This is related to the complexity of the model the learner is using to fit the data and generalize to unseen data. Implications for model selection and data mining will be explored.

Second, it is proposed to develop active algorithms which choose their own examples. This reduces the sample complexity of learning at the cost of an increased computational burden. Access to high performance computing will help greatly. Applications to function approximation, pattern classification and system identification will be explored.

Finally, the tools developed earlier will be applied to the domain of natural languages. In particular, the sample complexity of learning grammar will be investigated. At the same time the evolution of human languages can be modeled as a dynamical system. This can be used as an evolutionary criterion to choose between different linguistic theories (models).

CDA-9504056

\$46,195—24 mos

Prucnal, Paul R.

Princeton University

**CISE Postdoctoral Program: Ultrafast Multihop Transparent Optical Networks**

This is an award to Dr. Paul Prucnal to support Dr. Seung-Woo Seo as a postdoctoral associate. Dr. Seo will be working on ultrafast multihop transparent optical networks.

CDA-9503994

\$46,200—24 mos

Samet, Hanan

University of Maryland, College Park

**CISE Postdoctoral Program: Postdoctoral Research Associate in Experimental Science: Applying Computer Vision Methods to Image Databases**

One of the emerging areas of research is the integration of databases containing nontraditional data with conventional databases. New indexing methods are required in order to store and retrieve nontraditional data efficiently. These methods must capture the nature of the data and sort on this information. In this research the methods for integrating symbolic images into relational database systems will be extended to a more general case of images. The problem is how to match the stored image with an observed image that is presented to the database as a query, but is taken from a different viewpoint. A solution based on utilizing methods that are used in computer vision to solve these problems, and integrating these results into a relational (or any other) database system will be investigated. The solution is based on the use of geometric invariants. An additional research goal that extends this work into other nontraditional data types such as video data will also be performed. As video is becoming a common data type in information systems, data management systems should support this new kind of data. The important issue is how to extract contextual, spatial and temporal information from the video sequences in order to index on video data based on its contents. A solution that is based on gathering information about methods that are used for this purpose in computer vision, and adapting them so they can be used in the framework of database systems will be outlined. In particular, using a system that recognizes facial expressions from video sequences of a human face is suggested as a testbed.

CDA-9504275

\$46,200—24 mos

Warren, David S.

SUNY, Stonybrook

**CISE Postdoctoral Program: An Integrated Compilation System for Logic Programming Deductive Database and Non-Monotonic Reasoning**

The goal of this project is the design and implementation of a robust and efficient integrated optimizing compiler for the XSB system. XSB is a system that integrates logic programming, deductive databases and nonmonotonic reasoning. The combination of the three paradigms introduces challenges to the design of an optimizing compiler for the system. Firstly, the combination give rise to a number of unique optimization problems that are not germane to any one of the paradigms alone. Secondly, an efficient compilation system must integrate a suite of optimizations so as to extensively share ideas, formulations and implementation efforts. Some of the interesting optimization problems

relevant to XSB will be identified and some preliminary ideas for their solution will be sketched. A promising and powerful idea to integrate these optimizations through the use of constraints will be outlined. The potential impact of the techniques that will be developed

in this project to the optimization of functional and (constraint) logic programs will be shown. These techniques will form the foundations for an integrated optimizing compilation system that spans multiple languages and paradigms.

# CISE Instrumentation

CDA-9422007

\$39,429—12 mos

Beveridge, J. Ross

Colorado State University

## **CISE Research Instrumentation: Multiprocessor and Sensor Hardware for Vision, Learning Planning and Parallel Processing Research**

This award is to purchase two shared-memory multiprocessor systems, one with accelerated 3D graphics as required by the following research projects: 1) Computer Vision and Graphics; 2) Combinatorial Optimization Using Local and Global Search; 3) Machine Learning for Classification and Control; 4) Planning Agents in Dynamic Simulated Environments; 5) Comparing Functional Programming Languages.

Essential to these projects is the computational power of the multiprocessors. The equipment will provide a means to gain experience mapping algorithms onto coarse grain parallel hardware. Many parallel algorithms in these projects require a shared memory multiprocessor architecture. The vision, graphics, learning and planning projects explicitly benefit from the 3D graphics capability of the hardware. In addition to the above projects, this equipment will be available for exploration of new areas of research.

CDA-9422065

\$73,450—12 mos

Board, John A.

Duke University

## **CISE Research Instrumentation: Large Shard Memory Compute and Visualization Server for Algorithm and Numerical Method Development**

This award is to purchase a large, shared memory, multiprocessing workstation with accelerated 3-D graphics which will be dedicated to support research in computer and information science and engineering. The equipment will be used for several research projects, all of which require expensive computations to be performed on large data sets. The jump from two dimensional to three dimensional modeling in many of the application areas listed below requires a major increase in system memory and CPU power, and the 1 gigabyte memory shared between several processors will make many 3-D simulations possible. Visualizing the results of 3-D simulations in many scientific disciplines, and other image processing applications, is also a major challenge, requiring both significant CPU power and large

memory; the equipment is suited to this task as well. Five specific projects are: 1) parallel molecular dynamics computations, with particular attention to load balancing; 2) image compression using random neural networks; 3) parallel ocean acoustic signal processing; 4) extension of bi-domain methods for simulation of excitations in cardiac tissue to 3-D; and 5) visualization and analysis of large data sets from a 3-D ultrasound machine.

CDA-9422250

\$120,811—12 mos

Coyle, Edward J.

Purdue University

## **CISE Research Instrumentation: VIADUCT: A Testbed to Study Video, Image, Audio and Data Traffic on a High-Speed Network**

This award is to establish a testbed for both experimentation with and modeling and analysis of traffic on high-speed, heterogeneous, local area networks. The equipment purchased for the testbed includes three ATM switches, one of which provides access to other types of networks, and a high-performance workstation with extensive video capability. The following equipment will be connected to the testbed: 17 high-performance workstations located in various laboratories and research groups; two servers of, and the Ethernet backbone for the Engineering Computer Network (ECN), which supports over 12,000 users; and, at least two T1 lines provided by GTE for access to local hospitals and high schools. The testbed will have access to the Internet through the ECN. These connections will allow network traffic from many different applications to be brought into the testbed for study. The research this testbed will support includes: Modeling and analysis of network traffic statistics and network control algorithms; Communication network design and analysis; Discrete event system simulations driven by empirical data; Video and image compression algorithms for ATM networks; Distributed simulation and visualization for manufacturing and the teleoperation of robots.

CDA-9422071

\$59,352—12 mos

Crowl, Lawrence A.

Oregon State University

**CISE Research Instrumentation: Parallel Programming on Clusters of Multiprocessor Workstations**

This award is to purchase ATM networked multiprocessor workstation equipment which will be dedicated to support research in computer and information science and engineering. The equipment will be used for several research projects, including in particular: the abstraction techniques for parallel programming; the task-parallel programming environment; and the data-parallel programming environment.

In the first project, the proposed equipment will enable the researchers to design, implement and evaluate abstractions that can simultaneously exploit fast shared-memory communication and tolerate slow message-based communication. Furthermore, the proposed equipment will also enable researchers to do controlled experiments to determine application tolerance to communication latencies.

In the second project, the proposed equipment will enable researchers to investigate and develop a parallel programming environment for shared-memory multiprocessors clustered over a high speed ATM network. They will also develop schemes for partitioning and mapping of tasks and data for scheduling as well as load balancing. In addition, they will also be able to study the performance of scientific application programs.

In the third project, the researchers will be able to synthesize a new C\* compiler that generates code for a high-speed network of multiprocessor workstations. They will evaluate language extensions and, in particular, will incorporate explicit data decomposition directives, more general control flow, and parallel I/O into the language.

CDA-9422138

\$54,155—12 mos

Dorr, Bonnie

University of Maryland, College Park

**CISE Research Instrumentation: Hardware and Software for Large Scale Projects in Information Mediation, Language Translation and Text Filtering and Retrieval**

This award is to purchase equipment (cost-shared with The Institute for Advanced Computer Studies (UMIACS) and Department of Linguistics at the University of Maryland) dedicated to support specific projects in the laboratory for Computational Linguistics and Information Processing (CLIP). These projects are in the areas of information mediation, language translation and tutoring, and text filtering and retrieval. The software requirements include large dictionaries, corpora, data models

and databases, high-level database query languages, and a Prolog interpreter. Since many of these resources are available only on CD ROMs, the hardware requirements include an optical disk controller and large disks for storage. Also there is a need for two workstations with significant computing power for indexing and processing of text and installation of an object server. Finally, four Xterminals for extensive prototype development and an eye-tracker for testing hypotheses related to the development of psycholinguistically-grounded NLP models are needed.

CDA-9422095

\$71,411—12 mos

Dutt, Nikil D.

University of California, Irvine

**CISE Research Instrumentation: Laboratory for Design Methodologies of Embedded Systems**

This award is to purchase equipment for investigating methodologies for the concurrent design of embedded electronic systems involving both hardware and software, where teams of designers concurrently refine the initial product specifications into working prototypes. The research will adapt, evaluate and extend novel methodologies used in the traditionally distinct domains of hardware and software, and will attempt to quantify metrics for design cycle reduction, provide concurrent design process feedback and tune the design methodologies based on the domain of the application. Another important goal of the research is to investigate new paradigms for technology transfer between universities and industry with the objective of increasing the long-term impact of the technology transferred. Specifically, the research will 1) evaluate the proposed methodologies on realistic design examples provided by the industry, 2) increase university-industry interaction through on-site industrial visitors working closely with university researchers to test the proposed methodologies, and 3) facilitate better communication between university researchers and industrial partners through the use of multimedia platforms.

CDA-9422094

\$75,000—12 mos

Farag, Aly A.

University of Louisville

**CISE Research Instrumentation: Laboratory for Computer Vision and Image Processing (CVIP)**

Researchers at the University of Louisville will purchase equipment for research in the area of Computer Vision and Image Processing (CVIP). The equipment will be used for several projects including the following: 1) 3-D Model Building in Computer Vision: New

Approaches and Applications; 2) Integrated Image Segmentation; 3) Large Image Manipulation in Support of Optical Pattern Recognition; and 4) Fractional Brownian Motion for Representing Natural Image Texture.

The main components of the laboratory are: 1) Hardware for 3-D data acquisition and analysis (Silicon Graphics Iris Indigo 200/100MHz); 2) 3-D scanner for object scanning (Cyberware 3030-RGB/PS 3D Scanner&Table Bundle); 3) still-image capturing & display (Pullnix digital Camera, HP-C2732A X-terminals & Tektronix 3D display); and 4) image printing equipment (Codonics NP600 color dye sublimation printer, and slide write Polaroid CI-5000).

The equipment will be used for several research projects, including in particular: the implementation of data-parallel programs on clusters of high-speed processors utilizing a dedicated high-bandwidth network; the design, implementation and evaluation of extensions to the data-parallel programming model to support parallel I/O; the parallel implementation of the UNHFlexidesc system, which integrates scientific data visualization and database technology to support exploratory analysis of scientific data; the development of parallel algorithms for graphics and data visualization; the development of parallel algorithms for solving constraint satisfaction problems.

CDA-9422044

\$100,000—12 mos

Fischer, Thomas R.

Washington State University

**CISE Research Instrumentation: High Performance Networking and Computing Infrastructure for Image Research**

This award is to purchase high-performance networking and computing equipment which will be dedicated to support research in computer and information science and engineering. The equipment will be used for several research projects, including the following: Video compression algorithms will be developed for packet-switched networks, emphasizing robustness to packet loss and development of quantization methods that achieve most of the available granular and entropy gains. Distributed algorithms for computer vision will be developed, including techniques for parallel verification of hypotheses in three-dimensional object recognition, and techniques for high-performance sampling of discrete Markov Random Field models. A “virtual reality VCR” system, which was proposed as a mechanism for image-based recording and immersive playback of virtual environments, with particular emphasis on scientific documentation, will be prototyped. Finally, new techniques will be developed for recurrent design and automatic recurrent modeling of shapes in natural images.

CDA-9421997

\$121,547—12 mos

Hatcher, Philip J.

University of New Hampshire

**CISE Research Instrumentation: A High-Bandwidth Network Testbed for Parallel Computation**

This award is to purchase a cluster of 24 100MHz i486 systems connected via both an Ethernet and an ATM network constructed from 3 12-port ATM switches. Each i486 system will have sufficient main memory to allow large parallel computations to be run on the cluster and sufficient disk space to allow parallel I/O experiments to be performed. This equipment will be dedicated to supporting research in computer and information science and engineering.

CDA-9422195

\$15,872—12 mos

Healey, Glenn

University of California, Irvine

**CISE Research Instrumentation: Equipment for Developing Object Recognition Modules**

This award is to purchase computer equipment which will be dedicated to support research in computer and information science and engineering. This equipment will be used for several research projects, including in particular: 1) Image modeling and segmentation; 2) Algorithms for estimating illumination-invariant properties of objects; 3) Algorithms for estimating geometry-invariant properties of objects; and 4) Algorithms for cue integration for object recognition.

The four workstations will be used for the development of new color image models and associated algorithms for the estimation of object properties which are invariant to an object’s environment. New random field models will be developed that describe physically relevant interactions within and between bands of a color image. These image models will be parametrized by surface properties and scene conditions and will be used for image segmentation. Algorithms will also be developed which compute illumination-invariant and geometry-invariant properties of objects. These models and algorithms will be used by methods that rigorously combine estimated properties for object recognition. The proposed equipment will also allow experimentation with the developed models and algorithms on large databases to characterize performance and to suggest areas for future research.

CDA-9422146

\$88,018—12 mos

Huttenlocher, Daniel P.

Cornell University—Endowed

**CISE Research Instrumentation**

This award is to purchase equipment for support of research in Computer and Information Science and Engineering. Specifically, this award will be used for equipment to support several projects in the processing and analysis of digital video: 1) video motion analysis for annotation and browsing-detecting significant changes

in camera motion and tracking moving objects in order to automatically segment unstructured video; 2) adaptive video compression—using motion segmentation in compression; 3) video transcoding; 4) network protocols for continuous media; and 5) compression—tolerant image analysis—including development of algorithms that operate directly on compressed video data.

CDA-9422043

\$37,083—12 mos

Purushothaman-Iyer, S.

North Carolina State University

**CISE Research Instrumentation: Analysis and Verification of Concurrent Systems**

This award is to purchase equipment to support the following two research projects: 1) Automatic Tools for Verification and Debugging of Concurrent Programs and Designs—in order to deal with the state explosion phenomenon inherent in symbolic verification/analysis of concurrent programs and system designs, the first component of this project will involve the investigation of data flow and abstraction for concurrent systems. Reachability based techniques will also be considered for specific properties such as deadlock, starvation and livelocks in concurrent programs. Finally, better algorithms for explaining (to a system designer) the errors detected in a design will be investigated; 2) Error Control in High-Speed Networking—The use of conventional error detection in the face of transmission errors, and subsequent correction of the error, in high-speed networks can lead to rapid degradation of the network. This project will investigate new error control algorithms, their implementation and a study of their performance characteristics. A common characteristic of these two projects is that they involve algorithms which are computation, and memory, intensive.

CDA-9422069

\$100,000—12 mos

Jain, Ramesh C.

University of California, San Diego

**CISE Research Instrumentation: Equipment for Experimental Research in Visual Computing**

For the past decade, the importance of visual computing has increased exponentially. Visual computing, which embraces processing, interpreting, modeling, assimilating, storing and synthesizing visual information, now plays a pivotal role in many fields. These include such subjects as: virtual reality, multimedia, robotics, computer-human interaction, scientific visualization and communication. This award is to purchase equipment for supporting a number of ongoing research projects that are committed to this important field. The goal of these projects is to improve visual information computing through innovative experimental research. The equipment which includes two visualization systems, one real-

time image processing subsystem, and a number of visual sensors will be dedicated to support four individual research projects each addressing a different aspect of visual computing, namely Visual Information Assimilation, Visual Interaction through Gesture Recognition, Modeling and Design of Optoelectronic Visual Information Processors, and Physics-based Visualization of Multipedal Walking Systems.

CDA-9421935

\$75,429—12 mos

Kedem, Zvi M.

New York University

**CISE Research Instrumentation**

This award is to purchase a small network of workstations with accessories and software to support 4 research projects: 1) Further development of Calypso, a software-based execution platform for high-performance computing. This experimental project grew out of previous theoretical work dealing with abstract machines. The current prototype will be further enhanced and tested on selected applications. Special attention will be paid to scalability, load balancing, and fault tolerance. 2) Experimentation with Persistent Linda, an implementation of a fault-tolerant Linda built on top of lightweight transactions. Large-scale experimentation will be conducted using multiple machines executing long-running parallel computations. 3) Construction of an experimental platform for the easy implementation and evaluation of fundamental, symbolic computation algorithms. Special attention will be given to making the platform robust, flexible, and portable. 4) Distributed extension to a novel, centralized persistent object system will be developed. The system will be enhanced by new facilities such as type security, distributed locking, distributed synchronization, and collaborative applications.

CDA-9422014

\$81,017—12 mos

Koditschek, Daniel E.

University of Michigan, Ann Arbor

**CISE Research Instrumentation: Controllers and Visual Sensors for Advanced Robotics**

The University of Michigan has received an award to purchase real-time control and visual sensing hardware, to support research in five robotics projects in the Departments of Electrical Engineering and Computer Science. The research projects include parallel vibratory parts orientation, rigid body manipulations, dynamical acquisition of multiple objects, gestural input recognition systems for remote robot guidance and remote teleoperation, and dynamically interpreted gestural control.

CDA-9422106  
\$75,000—12 mos  
Leahy, Richard

University of Southern California

**CISE Research Instrumentation: A Computer Laboratory for Multi Dimensional Signal and Image Processing**

This award is to purchase equipment dedicated to research in computer and information science and engineering. Specifically, the equipment will be used for research in multi-dimensional signal and image processing, including in particular: 1) fusion of multimodal neuroimaging data; 2) adaptive quantization of image and video; 3) automatic target recognition via deformable template matching; 4) design of high resolution diffractive optics for photonic interconnections and computing; and 5) advanced adaptive multidimensional and array signal processing. Common to all of these projects is a need for access to fast numerical computation and high resolution visualization and display capabilities. The goal of this project is to set up a state of the art facility for processing, visualization and display of multidimensional data. Towards this end, a computer for high performance numerical computation, and a RAM-based workstation for display of high resolution video image sequences with a high performance graphics capability will be purchased.

CDA-9422288  
\$39,203—12 mos  
Lobo, Niels D.

University of Central Florida

**CISE Research Instrumentation: Specialized Equipment for Vision and Image Processing**

This award is to purchase a real-time vision system to assist research in three projects: 1) Classify Human Age from Faces; 2) Visual Gesture Recognition; and 3) Multi-frame Order Statistics in Image Processing.

In the first project, the research addresses the limited task of age classification of a facial image into a baby, young adult, and senior adult. It addresses the difficult issues of age classification of faces that are engaged in activity, i.e., not simply mugshots.

The second project investigates performing gesture recognition based on motion information. The current library of gestures contains seven gestures: Left, Right, Up, Down, Rotate, Grab, and Stop. It is proposed to extend the method to 3-D gesture recognition. A 3-D hand model using Generalized Cylinders, will be employed and motion parameters will be estimated to compute 3-D hand trajectories. Gesture recognition becomes more realistic with a 3-D, rather than a 2-D, approach.

The third project deals with the real-time performance of multi-frame order statistics involving median filtering. It is proposed to extend median and order statistic based filtering to 3-D by using spatio-temporal filtering (multiple successive images). It is also proposed to extend methods for suppression of narrow-band (periodic) interference to 2-D (for images).

CDA-9422092  
\$55,000—12 mos  
Medhi, Deepankar

University of Missouri

**CISE Research Instrumentation**

This award is to purchase multi-processor computer equipment which will be dedicated to support research in Computer Science Telecommunications Program at the University of Missouri-Kansas City. The equipment will be used for several research projects, including in particular: "Routing and Design of Wide-Area Broadband Networks," "Call Admission for Video Traffic in High Speed Networking," "High Speed Integrated ATM Networking," "Self-Routing and Network Embedding Problems in Parallel Processing," and "Evaluation of the Signaling System No. 7 Protocol for Emerging Services". To conduct these research projects, the hardware platform will be used for solving large-scale network optimization problems, for doing extensive simulation of networks and network protocols, for doing statistical analysis of traffic data, and for solving computing intensive problems in parallel processing. The multi-processor computers with large memories provide a flexible computing environment by making efficient use of resources and making it possible to solve large models in a timely manner, thus resulting in effective research.

CDA-9422135  
\$76,945—12 mos  
Moon, Jay

University of Minnesota

**CISE Research Instrumentation**

This award is to purchase equipment for characterizing major disturbances and designing effective equalization schemes for high density data storage channels. Advanced signal processing and communications techniques are playing an increasingly important role in improving reliability and storage capacity of magnetic data storage systems. Although similar to most communication channels in many respects, magnetic storage channels suffer from channel disturbances that are considerably different from those observed in other communication channels. Presently, a communication channel model describing the read and write processes in the high density magnetic channel corrupted by nonadditive media noise and nonlinear distortion is being developed. The effective equalization and channel estimation schemes suitable for magnetic recording under such severe channel conditions are also being investigated. Experimental disk spindle systems are under development to pursue the channel characterization and signal processing research. The equipment will be used to develop these experimental test spindle systems to support several research projects, including in particular: characterization of nonlinearity, design of nonlinear equalizers, adaptive channel identification/equalization, characterization of transition noise, and design of a read transducer for narrow track recording.

CDA-9422087

\$118,094—12 mos

Nakajima, Kazuo

University of Maryland, College Park

**CISE Research Instrumentation: High-Performance System Prototyping and Testing**

This award is to purchase a VLSI tester which will be dedicated to support research in computer and information science and engineering. The equipment will be used for several research projects, including in particular: High-frequency Digital and Analog Electronic and Optoelectronic Integrated Circuits, Prototyping and Testing Integrated Circuits for Biological Applications, Minimizing the Cost of Production Testing of Analog Integrated Circuits, Prototyping and Testing of High-Performance VLSI Signal/Image Processors, and Prototyping and Testing of Application-Specific RISC Processors and Concentrator Switches.

CDA-9421532

\$17,100—12 mos

Nelson, Randal C.

University of Rochester

**CISE Research Instrumentation: High-Performance Vehicle with Visual and Deictic Control**

This award is to support the research effort for the University of Rochester's Computer Science and Mechanical Engineering Departments to build and control a pair of small, off-road vehicles; one human-piloted, and one computer-controlled. Intrinsically interesting aspects of the equipment are low cost, off-road capability, and relatively high speeds (50 kph). The two vehicles will support research on semi-autonomous control, real-time visual processing, real-time decision-making, control learning, and simulation.

The research issues center around semi-autonomous or "deictic" control in which visual or symbolic commands are passed to the computer-controlled vehicle for local interpretation. This control style is increasingly popular for difficult, real-time control tasks (e.g. telemanipulation) in which neither full autonomy, nor direct teleoperation is feasible. Rochester will continue working on this topic.

Deictic control does not solve all control problems: control learning can play an important role. Two aspects of control learning will be investigated: learning tunable "motor skills" necessary to cope with high-speed situations, and, at a higher level, learning sequences of appropriate actions. Both types of learning are already under investigation at Rochester. Today's learning algorithms often receive initial training in simulation, so sophisticated simulation work already underway will be used.

CDA-9422038

\$150,000—12 mos

Rice, John R.

Purdue University

**CISE Research Instrumentation: High Performance Networks and Visualization**

This award is to purchase ATM network equipment and a high performance visualization machine to support five research projects. Four projects need to pre- and post-process massive data sets on a supercomputer; this requires high performance for both visualization graphics capabilities and networking. The fifth project needs the network for its studies in high performance interactive simulation with networks of heterogeneous computers. The network will connect the 140-processor Paragon in the Computing Center with research laboratories in the Computer Science Department; it will also interconnect various machines in these laboratories. The high performance graphics machine will allow effective visualization in the laboratory of massive data sets (3D to 5D with hundreds of megabytes) arising from 1) partial differential equations (5D data sets are generated by functions defined on 3 space dimensions and time), 2) geometry modeling and imaging in medical, geophysical and design applications, and 3) macromolecular structure analysis for viruses and proteins. The graphics machine will be shared with the heterogeneous network project.

CDA-9421531

\$50,000—12 mos

Salzberg, Steven L.

Johns Hopkins University

**CISE Research Instrumentation: Distributed Data Mining in Large Databases**

This award is to purchase equipment to be used for three distinct research projects. The first project focuses on computational biology, especially on distinguishing exons and introns in raw DNA sequence data using statistical analysis and machine learning algorithms. This project will also study algorithms for searching protein sequence databases to find fundamental building blocks called motifs. The second project is a continuation and extension of previous work on analysis of very large databases of astronomical images from the Hubble Space Telescope and ground-based telescopes. The development of automated classifiers to these databases is crucial for the success of astronomical sky surveys, in which data on hundreds of millions of celestial objects needs to be collected and classified in real time. In the third project, the research group will develop distributed versions of their corpus-based language learning algorithms, which will allow them to run many more experiments and to make much more rapid progress in this research area. The algorithms under development, which are computationally intensive, automatically acquire linguistic information from large text corpora, instead of hav-

ing people manually input this information based upon their linguistic intuitions.

CDA-9422033

\$104,000—12 mos

Schwan, Karsten

Georgia Techology of Institute

**CISE Research Instrumentation: Interactive Distributed Computing**

This award provides support for the acquisition of a computational cluster of 10 Sun SPARCstations, and 2 user-interface capable SGI Indy workstations. The research projects to be supported include interactive scientific programs, distributedcollaboration, interactive simulations, and efficient state sharing in interactive systems.

A goal of the research is to develop systems and user interface technologies that will allow the realistic solution of problems using computing, networking and user interface capabilities. Primary research projects include on-line interaction with scientific simulations running on multiple, networked parallel machines; collaboration support systems that will allow users to collaborate over long distances; interactive simulations that will allow end users to run and view system simulations in conjunction with actual system operation; and development of operating system technologies that address the efficient sharing of state on single parallel machines and across multiple networked workstations or super-computers.

CDA-9421978

\$110,651—12 mos

Singh, Ambuj

University of California, Santa Barbara

**CISE Research Instrumentation: A Proposal for High-Speed Cluster of Workstations**

This award is to purchase an ATM network which will be used for several research projects: design of a platform for evaluating shared memories and coherence protocols, networking research, image databases, and high performance transaction processing. The proposed research on distributed shared memories will extend an existing simulation and evaluation platform by providing efficient interfaces, implementation of objects, fault tolerance, and simulation using semantic information. The networking research will deal with a number of criti-

cal issues in ATM network design, modeling, and applications: traffic shaping, heterogeneous traffic modeling and measurement, the delivery of IP traffic over ATM, and the design and construction of native-mode ATM protocol stacks to support multimedia applications. The project on image databases will explore efficient content-based image retrieval mechanisms with the help of dynamic and adaptive index structures. The overall goal is to support efficient similarity queries as well as to develop fast browsing techniques. Finally, the proposed research on high performance transaction processing will implement and study the performance of a shared nothing system using weak memories and data partitioning techniques.

CDA-9422123

\$101,232—12 mos

Volz, Richard A.

Texas A&M University

**Instrumentation Grant for Research in CISE: Telecommuications in Virtual and Real Environments**

This award is to purchase equipment to support research in distributed real and virtual environments, including: 1) Attentive Model for Video Telecommunication—A framework for video analysis utilizing visual attention theory and eye movements is expected to yield high compression ratios; 2) Attention-Based Graphical Display of Complex Virtual Environments—An attentive display-time compression strategy will be developed, which tracksthe viewer's eyes and matches the imagery to the perceptual limitations of the human visual system; 3) Intelligent Control in a Telerobotic Network Using Predictive Simulated Reality—To counteract problems over long distances, predictive simulation and intelligent control are planned, in which the operator enters a virtual world corresponding to the real world; 4) Developing a General Framework for Natural and Precise Gestural Manipulations—A logical hand device to support precise and natural hand manipulations in virtual environments, e.g., a general framework to compose and manipulate 3-dimensional widgets and a sub-gesture alphabet to tokenize American Sign Language are presently being developed; 5) Rehabilitary Head Mounted Display Applications for the Physically Challenged—Virtual Reality technology are used to aide in the diagnosis and monitoring of subjects participating in physical rehabilitation and training programs, through the use of body tracking devices and Augmented Reality displays.

## CISE Special Projects

CDA-9412718

\$78,194—12 mos

Alo, Richard

University of Houston-Downtown

### **Special Project: Visiting Scientist Programs for Minority Institutions and Small Colleges**

This project is designed to strengthen the research and related educational activities in computer and information science and engineering at minority institutions without doctoral programs. For the twenty-five selected institutions, it provides funds for Visitation Programs by recognized computer scientists, engineers and educators who can respond to the needs of the program proposal submitted by the institution to the Program Committee and who will establish a working relationship with the institution that is expected to extend beyond the period supported by this grant. The project includes a strong evaluation component that extends throughout the period of the grant.

CDA-9522128

\$50,000—12 mos

Bennett, Jerome

NASA-Goddard Space Flight

### **Special Project: 5th Annual MU-SPIN Conference (1995) and Supplemental Support for on-campus Regional Training Workshop**

The Minority University Space Interdisciplinary Network, MU-SPIN, is a program for minority institutions, as well as colleges with significant minority enrollments, which is oriented around wide area networking technology and its use in supporting interdisciplinary research. Sponsorship is by the NASA Goddard Space Flight Center, Data and Computing Division, the University Programs Office, the Equal Opportunity Office, and NASA Headquarters. Based on the success of the 1991-1994 meetings, this project is to support the fifth meeting of the MU-SPIN User Working Group, October 4-7, 1995, at Morgan State University, as well as a set of smaller workshops to be held during the year as a supplement to the workshops are to provide opportunities for discussions on networking, communications, and infrastructure building and for the exchange of ideas on networking and communications to support interdisciplinary research. Funding will support the cost of participant travel, meals, and arrangements for the October meeting and expenses for the smaller workshops. The

project is directly related to the interests of the Computer and Information Science and Engineering Directorate in that CISE is actively supporting programs to enhance the opportunities of underrepresented populations in the computing field. Access to adequate facilities, and the interchange made available by the network connections is an important aspect of this effort, and the programs of the large October meeting and those of the smaller workshops are expected to enhance the opportunities of the participants.

CDA-9422295

\$225,000—12 mos

Blumenthal, Marjory S.

National Academy of Sciences

### **Renewal of Core Support for the Computer Science and Telecommunications Board**

This project analyzes a type of law that has become very important in the business economy of the United States, but that has been largely ignored by legal scholars: private commercial law developed by trade associations and enforced through association-run arbitration tribunals. This private law exists in a wide variety of industries such as grain, textiles, rubber, movies, and diamonds. It is embodied in detailed rules and standard form contracts that cover most of the same aspects of commercial transactions as the Uniform Commercial Code (UCC). These rules are supplemented by customs and usages of trade as well as by industry specific ethical codes that set out standards defining proper commercial behavior. These standards are similar to the UCC's obligations of good faith and fair dealing, but tend to be far more specific. The tribunals that enforce these rules operate under detailed procedural codes. This project will explore why these private legal systems developed and endured. In addition to in-depth case studies of several private law systems, the project will create a data base of trade rules, standard form contracts, ethical rules, association by-laws, and procedural rules, as well as information about the associations obtained through interviews. It will seek to establish the substance and extent of private commercial law and compare and contrast this law with the formal commercial law produced by the state. The analysis will be presented in a book entitled *THE NEWEST LAW MERCHANT: PRIVATE COMMERCIAL LAW IN THE UNITED STATES*. It will focus on the reasons for the development of the private law systems, the costs and benefits

associated with their use, and the mechanisms through which the enforcing tribunals achieve compliance with their rulings without recourse to the courts. It will thus make a contribution to understanding dispute resolution in the United States in both the private and public spheres.

CDA-9424506

\$14,866—12 mos

Carroll, John M.

Virginia Polytechnic Institute and State

(Split funded with Division of Information, Robotics and Intelligent Systems \$5,000 and Division of Networking and Communications Research and Infrastructure \$5,000) Total award \$24,866

#### **Building a History of the Blacksburg Electronic Village**

This project will organize extant documents and other related materials pertaining to the Blacksburg Electronic Village (BEV). In addition to facilitating the time-critical development of an in-depth history, this project will provide the beginning for a self-sustaining digital library for the BEV. As such it will be the first step in the development of histories of the evolving Village information systems and a reference model for other community networking projects.

CDA-9526518

\$47,725—12 mos

Coleman, Don

Association of Computer Science & Computer Engineering Departments at Minority Institutions

#### **Special Project: Curriculum Workshop on the Introduction of High Performance Computing into Undergraduate Computing Programs**

This award provides support for a workshop on "Introduction of High Performance Computing in Undergraduate Computing Programs" to be held at the 1995 ADMI meeting. The annual ADMI meeting brings together faculty from a large number of minority institutions. The goal of this workshop is to provide participants with a comprehensive overview of computational science curricula and hands-on experience with the use of the Internet and HPCC shared resources. The workshop program includes a series of lectures by experts in the field, discussion of possible curricula implementations, and demonstrations and hands-on experiences in the use of the Internet, Netscape, and the World Wide Web.

CDA-9503166

\$27,711—12 mos

Glinert, Ephraim

Rensselaer Polytech Institute

#### **Ensuring NII Accessibility: A Research Agenda**

This award is for the funding of travel and subsistence for participants in a workshop setting a research agenda for facilitating the use of the National Information Infrastructure by the handicapped and elderly. The

workshop is being held on October 30, 1994 and a report on the research agenda will be issued as part of this award.

CDA-9522903

\$25,000—12 mos

Kennedy, Ken

William Marsh Rice University

#### **Special Project: A Student Conference on Computational Science and Engineering for Minority Institutions in the South-Central United States**

This grant provides funding to support the travel of students selected to present research papers at the first student conference of the South-Central Computational Science in Minority Institutions Consortium (SC-COS-MIC). The consortium includes major research institutions, minority universities and colleges, community colleges, and independent school districts located in Louisiana, Texas, Oklahoma, Arkansas, New Mexico, and Arizona. Students from all of the institutions in the consortium are expected to present papers at the conference, which is scheduled for October 22-25, 1995.

CDA-9424504

\$31,150—12 mos

Lewis, Jesse C.

Norfolk State University

#### **Special Project: Maximizing The Impact of Conference Attendance Travel Grant: WCCE 95**

This grant is to provide partial support for 15 faculty members from minority institutions to attend the Sixth IFIP World Conference on Computers in Education in Birmingham, U.K., July 23-28, 1995. The 15 attendees are being selected from among the 120 individuals who were participants on similar NSF travel awards to the National Educational Computer Conferences (NECC), in 1992, 1993, and 1994, and are in attendance at NECC 95. Selection is based on specific accomplishments of the individual that resulted from participation in the previous conferences. This grant is expected to have significant impact on the professional development of faculty at minority institutions and hence on the human infrastructure of U.S. science and engineering.

CDA-9528079

\$49,986—12 mos

Vaina, Lucia

Boston University

#### **Special Project: The Majic Hat: An Adaptive Solution for Enhancing Visually Guided Mobility of the Visually Impaired**

This project is a Small Grant for Exploratory Research. The feasibility of new approaches to vision applied to recognition problems of use to the visually impaired is investigated. These approaches combine coarse, easily obtainable, visual data with novel adaptive learning algorithms to recognize features such as moving

objects and terrain irregularities. The results of this research project will be a feasibility study as to the robustness and practicality of this approach in developing a “magic hat”—an aid to the visually impaired consisting of a sensor and computation ring that would be worn by users as a hat and which adaptively warn the user of hazards.

CDA-9529074

\$168,080—12 mos

Weingarten, Frederick

Computer Research Association

**Working Symposium of New Information Technology and Education: A Research Agenda**

This workshop will bring together over 100 key researchers in computer science, and educational technology to discuss future trends in research and develop a research agenda. The workshop will have six parallel working sessions which will focus discussion and develop working papers on set of key research topics in the field of educational technology. These papers will be assembled with an overview paper and distributed widely.

CDA-9505200

\$8,000—12 mos

Yanco, Holly A

Wellesley College

(Split funded with Division of Information, Robotics and Intelligent Systems \$3,000) Total award \$11,000

**Special Project: Towards assistive robots for the disabled**

This project will adapt general mobile robotics research to the specific problem of a wheelchair robot. A wheelchair robot kit, with a notebook computer providing the platform for the user interface, will be utilized to create a low-cost, general-purpose wheelchair robot that can be used as a navigational assistant in wheelchair accessible indoor environments. The system is planned to be easy to use and to increase the efficiency of the user’s travel in the wheelchair.

Seven women students at Wellesley College will be involved with the Principal Investigator in the project. Since women are underrepresented in computer science and engineering in general and in robotics in particular, this project is particularly appropriate in the opportunity it provides to expose women undergraduates to possibilities in research activities and to encourage them to continue with further study in this area. With the planned complementary educational activities, the project will also bring new technical breadth to their computer science education at this liberal arts institution.

# CISE Research Experiences for Undergraduates

CDA-9322371

\$41,295—12 mos

Berque, David

Depauw University

## **REU Site: Research Experiences in Computer Science and Computational Mathematics for Undergraduates at Liberal Arts Colleges**

This program is intended to encourage talented undergraduates to pursue graduate study and research careers in Computer Science and Computational Mathematics. To achieve this goal, the program helps the students to experience, first-hand, several of the most rewarding activities that characterize most graduate programs and research careers. Specifically, the program gives eight student participants during each of three summers the opportunity to:

1. Conduct Research: Each of the eight students are paired with a faculty mentor who guides the student in carrying out a research project.

2. Disseminate Information: The program sponsors a seminar series in which the students regularly explain the progress of their research to the entire group. Each student also prepares a As part of the recruiting process, each C student provides a letter of support from a faculty member who agrees to arrange for the student to present the results of his/her research at the student's home institution during the following academic year.

3. Participate in a Community of Scholars: By providing a set of common experiences for the students, the program encourages these young researchers to build an informal community of scholars among themselves. The common experiences include participation in critiques of student talks, periodic group lunches, and attendance at presentations given by faculty members and guest speakers on various topics (e.g., discussion of a research interest, description of a particular career option, and discussion of the process of applying to graduate school.)

CDA-9322010

\$45,195—12 mos

Cordes, David

University of Alabama, Tuscaloosa

## **REU Site: University of Alabama Undergraduate Computer Science Research Program**

The University of Alabama Computer Science Undergraduate Research Program brings together nine stu-

dents from small schools throughout the South. They participate in ongoing research projects with the faculty members in the Computer Science Department (and closely related disciplines) at The University of Alabama. The program is ten weeks in duration, spanning the same time frame as the summer term at the University of Alabama.

Individuals from small, primarily undergraduate schools in the South are the major focus of this program. Emphasis is placed on the recruitment of female and minority students. The program actively recruits students from Colleges and Universities across the South. Students from institutions that lack a graduate program in Computer Science, as well as predominately minority institutions, are the major focus of the recruiting efforts. The program at the University of Alabama targets students who have completed three years of studies and have an interest in participating in current research efforts underway in the Department.

CDA-9423943

\$34,000—12 mos

Dershem, Herbert L.

Hope College

## **REU: An Undergraduate Research Participation Program in Computer Science**

The REU program at Hope College is designed to provide talented undergraduates with a meaningful research experience that will encourage them to consider in computer science research. The goal is to expose the students to the techniques, attitudes, and rewards of computer science research and to provide encouragement and direction in the pursuit of such a career. Women and minority students will be strongly recruited. Six participants will be selected each year, three from Hope College and three from other institutions. Those students will work for ten weeks during the summer in close collaboration with a Hope faculty mentor. Students will have the opportunity to use the Hope College Computer Science SUN SPARCstation network as well as the INMOS transputers. Areas of research include parallel algorithms, system development environments, data communications, voice recognition, graphics algorithms, algorithm animation, and programming language comparisons. The students will perform independent research, give oral presentations on their work, attend workshops on graduate school, prepare scientific papers, and present their work at seminars at their home institutions.

CDA-9542161  
\$4,131—6 mos  
Dershem, Herbert L.  
Hope College

**REU Supplement: An Undergraduate Research Participation Program in Computer Science**

This supplement to the REU Site Award at Hope College provides funds to cover the charge to the grant of the mandated cost of the employer's FICA contribution. This charge is due to changes in procedures at the College following an auditor's review and would otherwise result in a reduction in funds to the planned activities of the grant.

CDA-9424332  
\$63,652—12 mos  
Fox, Geoffrey  
Syracuse University

**REU: REU Site Program in High-Performance Computing and Communication**

The Northeast Parallel Architectures Center (NPAC) at Syracuse University will offer a summer REU site program for 12 undergraduate participants each year for 3 years. The program will offer research in High Performance Computing and Communications (HPCC) and will involve faculty from NPAC, the College of Engineering and Computer Science, the Department of Physics, and the Newhouse School of Public Communications. This program will be a continuation of the successful REU program at NPAC over the past four years. Research stipends will be awarded to talented and motivated undergraduate students entering their junior and senior years. At least 8 of the 12 REU participants will be selected from external applicants attending other colleges and universities. Women, minorities, and disabled students are especially encouraged to apply. The program will last 10 weeks each summer. The focus of the research topics will be high performance computing and communication applications in physics and media communications. Faculty will supervise projects in such topics as parallel computing languages, software and algorithms, computational fluid dynamics, computational physics, optimization problems, computer graphics and virtual reality, parallel databases, natural language processing, high-speed networking and ATM technologies, development and application of multimedia technologies such as video-on-demand and the World Wide Web, and the use of HPCC for education.

CDA-9424015  
\$46,263—12 mos  
George, K.M.  
Oklahoma State  
(Split funded with Division of Computer and Computation Research \$5,000) Total award \$51,263

**REU Site in Computer Science at Oklahoma State University**

This project will provide an environment for minority undergraduate students to experience research in Applied Computer Science. Ten minority students will be recruited to the REU program. Minority institutions without graduate programs in Computer Science will be the main focus of the recruitment effort. The major components of the REU program are a summer research project and a one day mini-seminar during the academic year. The participants will be given well defined research projects and will participate in ongoing research projects. They will also have the opportunity to interact with faculty and graduate students. The research projects will be designed such that the participants can be co-authors of papers. Such experience is expected to encourage the participants to continue their education into graduate school and move on to research careers. The participants will be matched with faculty members based on their interests. Examples of projects (not an exhaustive list) are simulation of architectures and protocols, and developing efficient implementations for abstract data types in shared memory and distributed memory machines. The participants will work in small groups under experienced professors. They will be expected to write a paper describing their research and present the results in a mini-seminar to be organized during the academic year. Contact with the students will be maintained throughout the academic year.

CDA-9224933  
\$40,000—12 mos  
Gray, Paul R.  
University of California, Berkeley  
**REU Site: Summer Undergraduate Program in Engineering at Berkeley**

This project will bring seven undergraduate students to the University of California, Berkeley for an eight week period in each of the summers of 1993, 1994, and 1995. The research projects will focus on microelectronics, communications, and computer science. The participants will have completed their junior year, and will all be women, or members of an underrepresented ethnic minority. In addition to working one-on-one with a faculty member in the Department of Electrical Engineering and Computer Science, each participant will be assigned to a graduate student co-mentor of the same gender or ethnicity.

CDA-9424195  
\$75,000—12 mos  
Guckenheimer, John M.  
Cornell University—Endowed

**REU Site: Supercomputing Program for Undergraduate Research (1995-1997)**

Under this three-year program, undergraduate students will investigate problems in a variety of areas of computational science research under the joint guidance of Cornell University faculty member and members of the Corand technical staff. While working on their research projects, students will not only participate in scientific research but will also learn about computational methods and receive training in high performance computing techniques. The research projects will take advantage of the advanced computational resources of the Theory Center including scaleable parallel processing and visualization tools. The research experience will be enhanced by the interaction among students from diverse institutions with multi-disciplinary backgrounds and research projects. Building on long-standing relationships, the project will aggressively recruit from historically black colleges and women's colleges; it will also target those institutions which lack a strong research orientation. Students at colleges and universities with otherwise limited computational research resources will thus have the opportunity to undertake significant research projects as part of their undergraduate education.

CDA-9424075  
\$41,186—12 mos  
Hodges, Larry  
Georgia Tech Research Corporation  
(Split funded with Division of Information, Robotics and Intelligent Systems \$5,000) Total award \$46,186

**REU: Software Development Experimental Quantification, and Application Development for Virtual Reality and Real-Time Visualization Systems**

This Research Experiences for Undergraduates project will support undergraduates to participate in research projects in the areas of computer graphics, virtual environments and visualization. The goal is to involve junior and senior students in a long term research experience (1-2 years) in which they make real contributions to the research, present papers at academic conferences, and author or co-author papers submitted to journals. The research project will focus on software and algorithm development, experimental quantification, and application development for virtual reality and real-time visualization systems. The student participants will be split into two groups of four each. One group will focus on the development of design tools for 3-D environments, image display techniques and algorithms, and application of virtual reality to exposure therapy. The other group will develop methods and tools for highly-interactive visualization and analysis in scientific applications. The methods and tools will be both for workstation-based and virtual environments and will be based

on a common set of principles. Undergraduate participants will work in a state-of-the-art visualization laboratory and will meet weekly with faculty members and graduate students who are also involved in these projects.

CDA-9322132  
\$77,868—12 mos  
Kearney, Joseph  
University of Iowa

**REU Site: Research Experience for Undergraduates at the Univ. of Iowa in Computer Vision, Robotics, Simulation, Virtual Environments, and Mobile Communication Systems**

This project supports undergraduate participation in research projects in the areas of computer vision, robotics, simulation, virtual environments, and mobile communication systems. Two programs are supported: A 10 week long, intensive summer program and a 30 week long program during the academic year. Research projects include: programming behaviors of simulated vehicles in virtual driving environments; simulating robot locomotion; integrating three-dimensional vision and graphics; programming texture description and stereo matching algorithms; and developing applications for mobile computers. The projects provide hands-on laboratory experience with state-of-the-art software and computing facilities working on challenging research problems.

CDA-9322276  
\$39,994—12 mos  
Liang, P  
University of California, Riverside

**REU Site: Recognition of 3-D Objects by Learning Networks**

This REU Site Program will provide eight undergraduate students with research training and experience. The students will participate in all phases of two research projects in 3-D object recognition and shape recovery using neural network learning. The projects are chosen since they involve several research areas that are currently active and are of practical importance, namely, 3-D object recognition, learning in computer vision, and neural networks. The ultimate goal of the proposed REU program is to provide an exciting and productive experience to the students that will expand their intellectual horizons and motivate them to a career in scientific inquiry and engineering innovation. Solid usable research results from the program, some of which may be of publishable quality, are expected. Selected students will join the research program in the summer after their junior year. The research will be contained for the whole senior year until their graduation. Theoretical understanding and hands-on problem solving will be equally emphasized. The research is to be carried out in the well-equipped Visualization and Intelligent System Laboratory. In order to broaden the base for attracting students to scientific careers, we plan to recruit four students from other institutions in the region. Because of the diversity

of the population of the region, we expect 50% of the participants to be minority and woman students.

CDA-9415573

\$37,210—12 mos

Loui, Ronald

Washington University

(Split funded with Division of Information, Robotics and Intelligent Systems \$5,000) Total award \$42,210

**REU Site: Summer Undergraduate Research Assistantship Program**

This Research Experiences for Undergraduates project will support eight to ten students per year in programs carried out during the Summers, for two years. Students will be involved in research projects across the interests of the department faculty, including AI and law, computer visualization, DNA mapping, medical informatics, distributed computing, neural networks, parallel architectures, and others. Students will be selected from institutions across the country based on selection criteria which include quality of background, research potential, diversity, and representation of underrepresented groups. Students will be matched to research professors based on faculty and students interests and prospects of success. The students will utilize all of the research facilities of the department including parallel processors, graphics systems, multimedia networking facilities, and the high-bandwidth switching network developed at the University.

CDA-9322553

\$38,723—12 mos

Messa, Kenneth

Loyola University

**REU Site: A Center for Undergraduate Research in Multi-Paradigm Design**

Many methodologies have been promoted for the development of large, complex software systems. Among these the most prevalent have been based upon the standard topdown structured analysis and design. This methodology is associated with the traditional procedure-oriented paradigm. However, the introduction of other paradigms such as logic-oriented, object-oriented and database-oriented paradigms suggested the possibility of developing new design methodologies. In particular, there is currently extensive research in integrating the logic-oriented, object-oriented and database-oriented design paradigms. The study of systems that are based on these multi-paradigms, provides a rich spectrum for undergraduate research.

Undergraduate research, like any other kind of research, is open-ended, requires innovation, and involves the incorporation of knowledge from a variety of sources. Research experiences includes experimentation, the comparison and evaluation of different viewpoints, and the production of publishable papers and their presentation to peer groups and professional organizations. The undergraduate researchers will review software devel-

opment methodologies and will get instruction on the use of CASE tools. They will gain insight into the multi-paradigms involved in the study, and, they will learn how different paradigms encourage alternate solutions to problems. This center has four primary goals:

(1) The involvement in research of undergraduates from underrepresented groups,

(2) The exposure of these undergraduates to the state-of-the-art software engineering methodologies,

(3) The research in multi-paradigm software design, and

(4) The production of undergraduate research papers which can be published and presented at regional or national conferences

CDA-9322248

\$60,000—12 mos

Miller, Thomas W.

University of New Hampshire

**Intelligent Structures Group Research Experiences for Undergraduates Site**

A Research Experiences for Undergraduates Site is being formed by the Intelligent Structures Group based within the Department of Electrical and Computer Engineering at the University of New Hampshire for a two year period starting in May, 1994. This REU site supports six students on a full-time basis during each summer and six students on a part-time basis during each academic year, allowing them to participate in research within the group. Activities of the group include all system aspects from theoretical analysis to prototype hardware implementation and evaluation. Basic research is performed in the areas of distributed fault-tolerance, neural networks, synthetic vision, and learning systems in control and signal processing.

The organization of the Intelligent Structures Group provides a combination of structure and diversity to enhance the student experience. Group members often collaborate on research, and meet to discuss research objectives, organize workshops for industry, and to coordinate equipment proposals and acquisitions. Through such interaction, student participants become familiar with the research programs of a number of faculty and graduate students as well as general issues of research administration. The diversity of the group's research offers a wide range of projects from neural network based learning in robotics to machine vision to VLSI design and implementation. This diversity makes it possible to stimulate students with a broad spectrum of professional interests.

CDA-9322249  
\$49,888—12 mos  
Pitts, Gerald  
Trinity University

**Computer Science Research Experiences for Undergraduates**

The Center for Undergraduate Research in Virtual Systems Development at Trinity University provides a unique opportunity for outstanding young undergraduate scholars to participate in a research experience in the challenging and exciting area of Virtual Reality. South Texas is a high percentage minority area and major effort is being waged to recruit minorities into the participant pool. Five participants will be selected for the 1994 summer research experience and, subsequently, ten participants will be selected for each of the following summers (1995 and 1996). Seven Professors of the Computer Science Department provide the research mentorship for students in seven different state-of-the-art aspects of Virtual Reality. Each student selects a research aspect area and mentor from research presentations/demonstrations during the first week of the Summer Research Experience. After eight weeks of intensive research, each student should have an in-depth understanding of research methodology, simulated world development, 3-D graphics, object oriented graphic design, intelligent systems and, consequently, Virtual Reality. Most research will be conducted in the newly created Meadows Scientific Visualization Laboratory that contains twenty-two (22) H.P. 9000 networked high-end processors with enhanced graphics capability. Participants will be expected to submit their research experience to either the ACM Annual SIGSE Conference or the National Conference on Undergraduate Research.

CDA-9500708  
\$40,300—12 mos  
Potts, Joseph  
GTE Laboratories

**REU Site Industrial Research for Undergraduates**

Under this project, GTE Laboratories will provide support for 15 undergraduate students per year as part of its ten week summer research program, now in its eighteenth year. Students are selected from a nation-wide applicant pool and assigned to a member of the Laboratories' technical staff to work on a pre-selected research project in the area of computer, information and telecommunications networks. Requirements include both oral and written reports. University faculty members play an important role in the selection and administration of the program. Strong efforts are made to recruit women and minorities.

CDA-9300580  
\$47,940—12 mos  
Roberts, James  
University of Kansas

**REU Site: Information Systems Engineering at the University of Kansas**

This project will bring ten undergraduates per summer to the University of Kansas campus to work with the Department of Electrical and Computer Engineering. The projects will be conducted in a ten week period in the summers of 1993, 1994, 1995. No More than two of the student participants per summer will be from the University of Kansas. The students will be working on existing research teams within the program. Special emphasis in the program is in the areas of microwave remote sensing, computer architecture, digital signal processing, artificial intelligence, telecommunications and networking, and very-large-scale-integration circuit design.

CDA-9424214  
\$56,000—12 mos  
Shah, Mubarak

University of Central Florida

(Split funded with Division of Social, Behavioral and Economic Research \$2,000) Total award \$58,000

**REU: Research Experiences for Undergraduates in Computer Vision**

This project represents a continuation of a Research Experience for Undergraduates site which has operated successfully for the past seven years. Over sixty undergraduate students from a half dozen institutions in Florida have participate in this program. The key distinctive elements of the approach at this institution are (1) to have a full calendar year experience planned for the participants, so that they have time to follow a substantial project of their own through to completion, (2) to present each participant with several possible project to topics, so that they can feel they have chosen a project which is most interesting to them, (3) to immerse the participants in the general research environment almost as if they were graduate students, by having them meet with the faculty member once each week to discuss their project, participate in the weekly research group meetings, attend research presentations and meet with visiting researchers, and (4) to follow through over the year by working with the students to write a technical report on their project, to study for the GRE's and to apply to graduate programs. In past years, a large fraction of the participants in this program have been able to prepare a paper for submission to a conference, have the paper accepted and then attend the conference to present the paper. Several past participants have even accomplished substantial enough research to also result in journal publications. Many of the past participants are now pursuing graduate studies at various institutions.

CDA-9300252  
\$40,725—12 mos  
Shirazi, Behrooz

University of Texas, Arlington

**Research Experiences for Undergraduates in Software  
Tools for Parallel Program Development and Assessment**

This project will bring seven students per year to the Computer Science Engineering Department's Architecture and Parallel Processing Laboratory at the University of Texas at Arlington. The focus of recruiting will be on upper division women, minority, and disabled students, with special emphasis on institutions in the Dallas/Fort Worth area that lack research facilities. The program will extend over a three year period. The students will investigate problems related to parallel program development, debugging, scheduling, and performance profiling.

CDA-9225044  
\$30,000—12 mos  
Thomas, David

Minnesota Institute of Technology

**Undergraduate Internship Program in Biophysical  
Computing and Graphics: Protein Structure and Dynamics**

This project will bring six undergraduate students to the Minnesota Supercomputer Institute in each of the summers of 1993, 1994, and 1995. The students will work on ongoing, and new research in biophysical computing and computational dynamics, and in new software development efforts for scientific computing and graphics support for such research.

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